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(54) Apparatus and Method for Using Encoded Video Recorder/Player Timer Preprogramming Information

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ABSTRACT OF THE DISCLOSURE

Encoded video recorder/player timer preprogramming information listed in a television guide allows a timer preprogramming feature on a video cassette recorder (VCR) to be programmed using a compressed code of only 1 to as few as 7 digits, which are decoded by a decoder built into either the video cassette recorder or a remote controller to convert the compressed code into channel, date, time and length information. The channel, date, time and length information is communicated to a VCR and used to automatically activate the VCR to record a given television program with the corresponding channel, date, time and length. Alternately, the channel, date, time and length information is decoded directly in a remote controller and only start record, stop record and channel selection commands are sent to the VCR at the appropriate times. The codes associated with each television program can be printed in a television program guide in advance and used with a VCR or remote controller with the decoding means. The compressed codes for timer preprogramming can be utilized for just one program or repeatedly for daily or weekly use. The algorithm for decoding the compressed codes can be a function of time to ensure security of the decoding method. A method is included for use of the compressed codes with cable channels and a method and apparatus is described for timer preprogramming for a large number of programs. The coding technique can also be used for compressed coding of any multidimensional vector for commercial or industrial applications.

APPARATUS AND METHOD FOR USING ENCODED VIDEO RECORDER/PLAYER TIMER PREPROGRAMMING INFORMATION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to video cassette recorder systems and particularly to the timer preprogramming feature of video cassette recorders (VCRs) and to an apparatus and method for using encoded information to shorten the time required to perform timer preprogramming.

2. Prior Art

The video cassette recorder (VCR) has a number of uses, including playing back of tapes filmed by a video camera, playing back of pre-recorded tapes, and recording and playing back of broadcast and cable television programs.

To record a television program in advance of viewing it, a two-step process is often used: (1) obtain the correct channel, date, time and length (CDTL) information from a television program guide, and (2) program this CDTL information into the VCR. Depending on the model, year and type of the VCR, the CDTL information can be programmed in various ways including: (i)

pushing an appropriate sequence of keys in the console according to instructions contained in the user's manual, (ii) pushing an appropriate sequence of keys in a remote hand-held control unit according to instructions contained in the user's manual (remote programming), and (iii) executing a series of keystrokes in the remote hand-held control unit in response to a menu displayed on the television screen (on-screen programming). Other techniques for timer preprogramming have been suggested including: (iv) reading in certain bar-code information using a light pen (light pen programming), and (v) entering instructions through a computer or telephone modem. These various methods differ only in the physical means of specifying the information while the contents, being CDTL and certain power/clock/timer on-off commands are generally common although the detailed protocol can vary with different model VCRs. Methods (i) and (ii) described above can require up to 100 keystrokes, which has inhibited the free use of the timer preprogramming feature of VCRs. To alleviate this, new VCR models have included an "On-Screen Programming" feature, which permits remote input of CDTL information in response to a menu displayed on the television screen. Generally on screen programming of CDTL information requires an average of about 18 keystrokes, which is less than some of the prior methods but still rather substantial. Some of the other techniques such as (iv) above, require the use of special equipment such as a bar code reader.

In general the present state of the art suffers from a number of drawbacks. First, the procedure for setting the VCR to record in advance can be quite complex and confusing and difficult to learn; in fact, because of this many VCR owners shun using the timer preprogramming record feature. Second, the transcription of the CDTL information to the VCR is hardly ever error-free; in fact, many users of VCR's timer preprogramming features express concern over the high incidence of programming

errors. Third, even for experienced users, the process of entering a lengthy sequence of information on the channel, date, time and length of desired program can become tedious. Fourth, techniques such as reading in bar-code information or using a computer require special equipment. These drawbacks have created a serious impedance in the use of a VCR as a recording device for television programs. The effect is that time shifting of programs has not become as popular as it once was thought it would be. Accordingly, there is a need in the art for a simpler system for effecting VCR timer preprogramming which will enable a user to take advantage of the recording feature of a VCR more fully and freely.

SUMMARY OF THE INVENTION

A principal object of the invention is to provide an improved system for the selection and entering of channel, date, time and length (CDTL) information by a user required for timer preprogramming of a VCR which is substantially simpler, faster and less error-prone than present techniques.

In accordance with the invention, to program the timer preprogramming feature of a video system, there is an apparatus and method for using encoded video recorder/player timer preprogramming information. The purpose is to significantly reduce the number of keystrokes required to set up the timer preprogramming feature on a VCR. In accordance with this invention it is only necessary for the user to enter a code with 1 to 7 digits or more into the VCR. This can be done either remotely or locally at the VCR. Built into either the remote controller or the VCR is a decoding means which automatically converts the code into the proper CDTL programming information and activates the VCR to record a given television program with

the corresponding channel, date, time and length. Generally multiple codes can be entered at one time for multiple program selections. The code can be printed in a television program guide in advance and selected for use with a VCR or remote controller with the decoding means.

Other objects and many of the attendant features of this invention will be more readily appreciated as the same becomes better understood by reference to the following detailed descriptions and considered in connection with the accompanying drawings in which like reference symbols designate like parts throughout the figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic showing apparatus according to this invention with the code decoder means embedded in the video cassette recorder.

FIG. 2 is a schematic of the VCR embedded processors for command control and code decoding.

FIG. 3 is a schematic showing apparatus according to this invention with the code decoder means embedded in a remote controller.

FIG. 4 is a schematic of the processor embedded in the remote controller.

FIG. 5 is a schematic of a universal remote controller with the code decoder means embedded in the universal remote controller.

FIG. 6 is a flow graph of the G-code decoding technique.

FIG. 7 is a flow graph of the G-code encoding technique.

FIG. 8 is an illustration of part of a television calendar according to this invention.

FIG. 9 is a flowchart for decoding for cable channels.

FIG. 10 is a flowchart for encoding for cable channels.

FIG. 11. is a flow graph of the G-code decoding for cable channels including conversion from assigned cable channel number to local cable carrier channel number.

FIG. 12 is a means for decoding including a stack memory.

FIG. 13 is a flowchart for program entry into stack memory.

FIG. 14 is a operation flowchart for sending programs from remote control to main unit VCR.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and more particularly, to FIG. 1, there is shown an apparatus for using encoded video recorder/player timer preprogramming information 10 according to this invention. The primary components include a remote controller 12 and a video cassette recorder/player with G-code decoder 14, which can be controlled by remote controller 12 via a command signal 16. The remote controller 12 can have a number of keys, which include numerical keys 20, G-code switch 22, function keys 24, program key 26 and power key 27. There are means in the

remote controller 12 that interpret each key as it is pressed and send the proper command signal 16 to the VCR via an infra-red light emitting diode 28. Except for the G-code switch 22 on the remote controller 12 in FIG. 1, the remote controller 12 is essentially the same as any other remote controller in function. The G-code switch 22 is provided just to allow the user to lock the remote controller 12 in the G-code mode while using a G-code, which is the name given to the compressed code which is the encoded CDTL information, to perform timer preprogramming.

A G-code consists of 1 to 7 digits, although more could be used, and is associated with a particular program. A user would lookup the G-code in a program guide and just enter the G-code on the remote controller 12, instead of the present state of the art, which requires that the user enter the actual channel, date, time and length (CDTL) commands.

In order to understand the advantages of using a G-code, it is helpful to describe the best of the current state of the art, which is "on screen programming" with direct numerial entry. This technique involves about 18 keystrokes and the user has to keep switching his view back and forth between the TV screen and the remote controller while entering the CDTL information. This situation may be akin to a user having to dial an 18 digit telephone number while reading it from a phone book. The number of keys involved and the switching back and forth of the eye tend to induce errors. A typical keying sequence for timer recording using on-screen CDTL programming is as follows:

PROG 2 1 15 07 30 2 08 00 2 04 PROG

The first program (PROG) key 26 enters the programming mode. Then a sequence of numericals key 20 are pushed. The 2 means it is timer recording rather than time setting. The 1 means the

user is now entering the settings for program 1. The 15 is the date. The 07 is starting hour. The 30 is a starting minute. The 2 means pm. The next sequence 08 00 2 is the stopping time. The 04 is channel number. Finally, the PROG is hit again to exit the program mode.

By contrast, this command could have been "coded" and entered in a typical G-code sequence as follows: PROG 1138 PROG. To distinguish that the command is a coded G-code, the G-code switch 22 should be turned to the "ON" position. Instead of having a switch, a separate key "G" can be used. The G-code programming keystroke sequence would then be: G 1138 PROG.

The use of a G-code does not preclude "on-screen" confirmation of the program information that has been entered. When the keystrokes "PROG 1138 PROG" are entered with the G-code switch in the "ON" position, the G-code would be decoded and the television could display the following message:

PROGRAM	DATE	START TIME	STOP TIME	CHANNEL
1138	15	7:30 PM	8:00 PM	4

In order for the G-code to be useful it must be decoded and apperatus for that purpose must be provided. Referring to FIG. 1, a video cassette recorder/player with G-code decoder 14 is provided to be used in conjunction with remote controller 12. The command signal 16 sent from the remote controller 12 is sensed by the photodiode 32 and converted to electrical signals by command signal receiver 30. The electrical signals are sent to a command controller 36, which interprets the commands and determines how to respond to the commands. As shown in FIG. 1, it is also possible for the command controller 36 to receive commands from the manual controls 34 that are normally built into

a VCR. Other possible command sources include voice if a speech recognizer is incorporated into the VCR and a bar code scanner. If the command controller 36 determines that a G-code was received then the G-code will be sent to the G-code decoder 38 for decoding. The G-code decoder 38 converts the G-code into CDTL information, which is used by the command controller 36 to set the time/channel programming 40. Built into the VCR is a clock 42. This is normally provided in a VCR and is used to keep track of the date and time. The clock 42 is used primarily by the time/channel programming 40 and the G-code decoder 38 functions. The time/channel programming 40 function is set up with CDTL information by the command controller 36. When the proper date and time is read from clock 42, then the time/channel programming 40 function turns the record/playback 44 function on to record. At the same time the tuner 46 is tuned to the proper channel in the television signal 18.

An alternate way to control the recorder is to have the command controller 36 keep all the CDTL information instead of sending it to the time/channel programming 40. The command controller would also keep track of the time by periodically reading clock 42. The command controlier would then send commands to the time/channel programming 40 to turn on and off the recorder and to tuner 46 to cause it to tune to the right channel at the right time according to the CDTL information.

The clock 42 is also an input to G-code decoder 38, which allows the G-code decoding to be a function of the clock, which lends a measure of security to the decoding technique and makes it harder to copy. Of course this requires that the encoding technique must also be a function of the clock.

A possible realization of the command controller 36 and the G-code decoder 38 is shown in FIG. 2. The command controller 36

function can be realized with a microprocessor 50, a random access memory 52 and a read only memory 54, which is used for program storage. The input/output 56 function is adapted to receive commands from the command signal receiver 30, the manual controls 34 and the clock 42, and to output signals to a display 35, the clock 42, and the time/channel programming 40 function. If the microprocessor 50 interprets that a G-code has been received, then the G-code is sent to microcontroller 60 for decoding. The microcontroller 60 has an embedded random access memory 62 and an embedded read only memory 64 for program and table storage. The clock 42 can be read by both microprocessor 50 and microcontroller 60.

An alternative to having microcontroller 60 perform the G-code decoding is to build the G-code decoding directly into the program stored in read only memory 54. This would eliminate the need for microcontroller 60. Of course, other hardware to perform the G-code decoding can also be used. The choice of which implementation to use is primarily an economic one.

The blocks in Figs. 1 and 2 are well known in the prior art and are present in the following patents: Fields, patent no. 4,481,412; Scholz, patent no. 4,519,003; and Brugliera, patent no. 4,631,601. For example, clock 42 is analogous to element 7 in Scholz and element 17 in Brugliera. Other analogous elements are: command signal receiver 30 and Scholz 14 and Brugliera 12; tuner 46 and Scholz 6 and Brugliera 10; time/channel programming 40 and Scholz 8, 11 and Brugliera 16; record & playback 44 and Scholz 1, 2, 4; command controller 36 and Scholz 11, 10 and Brugliera 12; microprocessor 50 and Fields 27; RAM 62 and Fields 34; ROM 54 and Fields 33; manual controls 34 and Scholz 15, 16; and remote controller 12 and Scholz 26 and Brugliera 18.

FIG. 3 illustrates an alternate preferred embodiment of this invention. In FIG. 3 a remote controller with embedded G-code decoder 80 is provided. The remote controller with embedded G-code decoder 80 is very similar to remote controller 12, except for the addition of the G-code decoder 82. Note that it is also possible in any remote controller to provide a display 84. The remote controller with embedded G-code decoder 80 would be used in conjunction with a normal video cassette recorder/player 70, which would not be required to have an embedded G-code decoder. The numerals for the subelements of video cassette recorder/player 70 are the same as described above for the video cassette recorder/player with G-code decoder 14 and have the same function, except for the absence of G-code decoder 28. This preferred embodiment has the advantage that it can be used in conjunction with VCRs that are presently being used. These do not have a G-code decoding capability. Replacing their remote controllers with ones that have this capability built-in can vastly improve the capability to do timer preprogramming for a modest cost.

FIG. 4 illustrates a possible realization of the G-code decoder 82 built into the remote controller with embedded G-code decoder 80. A microprocessor 60 can be used as before to decode the G-code, as well as interface with the display 84, a clock 85, the keypad 88 and the light emitting diode 28. Alternately, other hardware implementations can be used to perform the G-code decoding. The clock is provided in the remote controller 80 so that the G-code decoder 82 can be made to have the clock as one of its inputs. This allows the G-code decoding to be a function of the clock, which lends a measure of security to the decoding technique and makes it harder to copy.

The remote controller with embedded G-code decoder as described above would send channel, date, time and length

information to the video cassette recorder/player 70, which would use the CDTL information for tuning into the correct channel and starting and stopping the recording function. The remote controller may have to be unique for each different video cassette recorder/player, because each brand or model may have different infrared pulses for each type of information sent such as the channel number keys and start record and stop record keys. The particular infrared pulses used for each key type can be called the vocabulary of the particular remote controller. Each model may also have a different protocol or order of keys that need to be pushed to accomplish a function such as timer preprogramming. The protocol or order of keys to accomplish a function can be called sentence structure. If there is a unique remote controller built for each model type, then the proper vocabulary and sentence structure can be built directly into the remote controller.

An alternate to having the remote controller with embedded G-code decoder send channel, date, time and length information to the video cassette recorder/player 70, is to have the remote controller with embedded G-code decoder perform more operations to simplify the interfacing problem with existing video cassette recorder/players. In particular, if the remote controller not only performs the G-code decoding to CDTL, but also keeps track of time via clock 85, then it is possible for the remote controller to send just channel, start record and stop commands to the video cassette recorder/player. These are usually basic one key commands, which means there is no complicated protocol or sentence structure involved. Thus, to communicate with a diverse set of video cassette recorder/player models it is only necessary to have memory within the remote controller, such as ROM 64 of FIG. 4, for storing the vocabulary for all the models or at least a large subset. The G-code would be entered on the remote controller as before and decoded into channel, date, time and

length information, which would be stored in the remote controller. Via clock 85, the time would be checked and when the correct time arrives the remote controller would automatically send out commands to the VCR unit for tuning to the correct channel and for starting and stopping the recording. It is estimated that only two (2) bytes per key for about 15 keys need to be stored for the vocabulary for each video cassette recorder/player model. Thus, to cover 50 models would only require about 30*50 = 1500 bytes of memory in the remote controller. It would be necessary to position the remote controller properly with respect to the VCR unit so that the sent infrared signals sent by the remote controller are received by the unit.

Another preferred embodiment is to provide a universal remote controller 90 with an embedded G-code decoder. Universal remote controllers provide the capability to mimic a number of different remote controllers. This reduces the number of remote controllers that a user needs to have. This is accomplished by having a learn function key 94 function on the universal remote controller, as shown in FIG. 5. If the learn function key 94 is pushed in conjunction with another key, the unit will enter into the learn mode. Incoming infra-red (IR) pulses from the remote controller to be learned are detected by the infra-red photodiode 96, filtered and wave-shaped into recognizable bit patterns before being recorded by a microcontroller into a battery-backed static RAM as the particular IR pulse pattern for that particular key. This is done for all the individual keys.

An example of more complex learning is the following. If the learn function key 94 in conjunction with the program key 26 are pushed when the G-code switch is "ON", the unit will recognize that it is about to record the keying sequence of a predetermined specific example of timer preprogramming of the

particular VCR involved. The user will then enter the keying sequence from which the universal remote controller 90 can then deduce and record the protocol of the timer preprogramming sequence. This is necessary because different VCRs may have different timer preprogramming command formats.

If keys are pushed without the learn function key 94 involved, the microcontroller should recognize it is now in the execute mode. If the key is one of the direct command keys, the microcontroller will read back from its static RAM the stored pulse sequence and send out command words through the output parallel I/O to pulse the output light emitting diode 28. If the key is the PROG key and the G-code switch is "OFF", then the microcontroller should recognize the following keys up to the next PROG key as a timer preprogramming CDTL command and send it out through the light emitting diode 28. If the G-code switch 22 is set to "ON" and the program key 26 is pushed, the microcontroller should recognize the following keys up to the next PROG key as a G-code command for timer preprogramming. It will decode the G-code into channel, date, start time and length (CDTL) and the microcontroller will then look up in it's static RAM "dictionary" the associated infra-red pulse patterns and concatenate them together before sending them off through the output parallel I/O to pulse the light emitting diode 28 to send the whole message in one continuous stream to the VCR.

FIG. 4 illustrates a possible realization of the G-code decoder 92 that could be built into the universal remote controller with embedded G-code decoder 90. A microcontroller 60 can be used as before to decode the G-code, as well as for interfacing with the input/output functions including the photodiode 96. Alternately, the G-code decoding can be performed with other hardware implementations.

The universal remote controller can also be used in another manner to simplify the interfacing problem with existing video cassette recorder/players. In particular, if the universal remote controller performs not only the G-code decoding to CDTL, but also keeps track of time via clock 85 in FIG. 4, then it is possible for the universal remote controller to send just channel, start record and stop commands to the video cassette recorder/player, which as explained before, are usually basic one key commands, which means there is no complicated protocol or sentence structure involved. Thus, to communicate with a diverse set of video cassette recorder/player models it is only necessary for the universal remote controller to "learn" each key of the remote controller it is replacing. The G-code would be entered on the universal remote controller as before and decoded into channel, date, time and length information, which would be stored in the universal remote controller. Via clock 85, the time would be checked and when the correct time arrives the universal remote controller would automatically send out commands to the VCR unit for tuning to the correct channel and for starting and stopping the recording. It would be necessary to position the universal remote controller properly with respect to the VCR unit so that the signals sent by the universal remote are received by the VCR unit.

There are a number of ways that the G-code decoding can be performed. The most obvious way is to just have a large look up table. The G-code would be the index. Unfortunately, this would be very inefficient and result in a very expensive decoder due to the memory involved. The total storage involved is a function of the number of total combinations. If we allow for 128 channels, 31 days in a month, 48 on the hour and on the half hour start times in a twenty four hour day, and 16 length selections in half hour increments, then the total number of combinations is $128 \times 31 \times 48 \times 16 = 3,047,424$. This number of combinations can be

represented by a 7 digit number. The address to the table would be the 7 digit number. In the worse case, this requires a lookup table that has about 4,000,000 rows by 15 to 16 digital columns, depending on the particular protocol. These digital columns would correspond to the CDTL information required for "on screen programming". Each digit could be represented by a 4 bit binary number. Thus, the total storage number of bits required for the lookup table would be about 4,000,000x16x4 = 256,000,000. The present state of the art has about 1 million bits per chip. Thus, G-code decoding using a straightforward table lookup would require a prohibitively expensive number of chips.

Fortunately, there are much more clever ways of performing the G-code decoding. FIG. 6 is a flow diagram of the preferred G-code decoding technique. To understand G-code decoding, it is easiest to first explain the G-code encoding technique, for which FIG. 7 is the flow chart. Then the G-code decoding technique, which is the reverse of the G-code encoding will be explained.

The encoding of the G-codes can be done on any computer and is done prior to preparation of any program guide that would include G-codes. For each program that will be printed in the guide, a channel, date, time and length (CDTL) code 144 is entered in step 142. Step 146 separately reads the priority for the channel, date, time and length in the priority vector storage 122, which can be stored in read only memory 64. The priority vector storage 122 contains four tables: a priority vector C table 124, a priority vector D table 126, a priority vector T table 128 and a priority vector L table 130.

The channel priority table is ordered so that the most frequently used channels have a low priority number. An example of the data that is in priority vector C table 124 follows.

channel	4	7	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

Generally the dates of a month all have an equal priority, so the low number days in a month and the low number priorities would correspond in the priority vector D table as in the following example.

date	1	2	3	4	5	6	7	8	9	10 ..
priority	0	1	2	3	4	5	6	7	8	9 ..

The priority of the start times would be arranged so that prime time would have a low priority number and programs in the dead of the night would have a high priority number. For example, the priority vector T table would contain:

time	6:30pm	7:00pm	8:00pm	7:30pm	...
priority	0	1	2	3	...

An example of the data that is in the priority vector L table 130 is the following:

length of program (hours)	0.5	1.0	2.0	1.5	3.0	...
priority	0	1	2	3	4	...

Suppose the channel date time length (CDTL) 144 data is 5 10 19.00 1.5, which means channel 5, 10th day of the month, 7:00 PM, and 1.5 hours in length, then the C_p, D_p, T_p, L_p data 148 for the above example would be 4 9 1 3. Step 150 converts C_p, D_p, T_p, L_p data to binary numbers. The number of binary bits in each conversion is determined by the number of combinations involved. Seven bits for C_p, which can be denoted as $C_7\ C_6\ C_5\ C_4\ C_3\ C_2\ C_1$, would provide for 128 channels. Five bits for D_p, which can be denoted as $D_5\ D_4\ D_3\ D_2\ D_1$, would provide for 31 days in a month.

Six bits for T_p, which can be denoted as T_6 T_5 T_4 T_3 T_2 T_1, would provide for 48 start times on each half hour of a twenty four hour day. Four bits for length, which can be denoted as L_4 L_3 L_2 L_1, would provide for a program length of up to 8 hours in half hour steps. Together there are 7+5+6+4 = 22 bits of information, which correspond to 2**22 = 4,194,304 combinations.

The next step is to use bit hierarchy key 120, which can be stored in read only memory 64 to reorder the 22 bits. The bit hierarchy key 120 can be any ordering of the 22 bits. For example, the bit hierarchy key might be:

L_8	C_3	...	T_2	C_2	T_1	C_1	L_1	D_5	D_4	D_3	D_2	D_1
22	21	...	10	9	8	7	6	5	4	3	2	1

Ideally the bit hierarchy key is ordered so that programs most likely to be the subject of timer preprogramming would have a low value binary number, which would eliminate keystrokes for timer preprogramming the most popular programs. Since all the date information has equal priority, then the D_5 D_4 D_3 D_2 D_1 bits are first. Next T_1 C_1 L_1 are used, because for whatever date it is necessary to have a time channel and length and T_1 C_1 L_1 are the most probable in each case due to the ordering of the priority vectors in priority vector storage 122. The next bit in the hierarchy key is determined by the differential probabilities of the various combinations. One must know the probabilities of all the channels, times and lengths for this calculation to be performed.

For example, the probability for channels may be:

channel	4	7	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

probability(%)	5	4.3	4	3	2.9	2.1	2	1.8	...

The probabilities for times might be:

time	6:30pm	7:00pm	8:00pm	7:30pm	...
priority	0	1	2	3	...
probability(%)	8	7.8	6	5	...

And, the probabilities for lengths might be:

length of program (hours)	0.5	1.0	2.0	1.5	3.0	...
priority	0	1	2	3	4	...
probability(%)	50	20	15	5	4	...

The probabilities associated with each channel, time and length, as illustrated above, are used to determine the proper ordering. Since the priority vector tables are already ordered by the most popular channel, time, and length, the order in which to select between the various binary bits for one table, for example selecting between the C_7 C_6 C_5 C_4 C_3 C_2 C_1 bits, is already known. The C_1 bit would be selected first because as the lowest order binary bit it would select between the first two entries in the channel priority table. Then the C_2 bit would be selected and so on. Similarly, the T_1 and L_1 bits would be used before any of the other time and length bits. A combination of the C_1, T_1, L_1 and D_5 D_4 D_3 D_2 D_1 bits should be used first, so that all the information is available for a channel, date, time and length. The D_5 D_4 D_3 D_2 D_1 bits are all used because the date bits all have equal priority and all are needed to specify a date even if some of the bits are binary zero.

At this point the bit hierarchy key could be:

T_1 C_1 L_1 D_5 D_4 D_3 D_2 D_1

The first channel binary bit C_1 by itself can only select between $2^1 = 2$ channels, and the first two channels have a probability percent of 5 and 4.3, respectively. So the differential probability of C1 is 9.3. Similarly, the differential probability of T_1 is 8 + 7.8 = 15.8, and the differential probability of L_1 is 50 + 20 = 70. If the rules for ordering the bit hierarchy key are strictly followed, then the first 8 bits of the bit hierarchy key should be ordered as:

$$C_1\ T_1\ L_1\ D_5\ D_4\ D_3\ D_2\ D_1,$$

because L_1 has the highest differential priority so it should be first, followed by T_1, and then C_1.

The question at that point is what should the next bit in the hierarchy key be: T_2, C_2, or L_2. This is determined by the differential probabilities, which can be calculated from the above tables for each bit. Since we are dealing with binary bits, the C_2 in combination with C_1 selects between $2^2 = 4$ channels or 2 more channels over C_1 alone. The differential probability for C_2 is then the additional probabilities of these two additional channels and for the example this is: 4 + 3 = 7. In a similar manner C_3 in combination with C_1 and C_2 selects between $2^3 = 8$ channels or $4 = 2^{(3-1)}$ more channels over the combination of C_1 and C_2. So the differential probability of C_3 is the additional probabilities of these four additional channels and for the example this is: 2.9 + 2.1 + 2 + 1.8 = 8.8. In a similar manner, the differential probabilities of T_2 and L_2 can be calculated to be 6 + 5 = 11 and 15 + 5 = 20, respectively. Once all the differential probabilities are calculated, the next step is determining which combinations of bits are more probable.

Now for the above example, which combination is more probable: T_2 with C_1 L_1, or C_2 with T_1 L_1, or L_2 with T_1 C_1. This will determine the next bit in the key. So, which is greater: 11x9.3x70= 7161; 7x15.8x70= 7742; or 20x15.8x9.3= 2938.8? In this case the combination with the greatest probability is 7x15.8x70= 7742, which corresponds to C_2 with T_1 L_1. So, C_2 is selected as the next bit in the bit hierarchy key.

The next bit is selected in the same way. Which combination is more probable: C_3 with T_1 L_1, or T_2 with C_1 or C_2 and L_1, or L_2 with C_1 or C_2 and T_1. For the example shown, which has the greatest probability: 8.8x15.8x70= 9732.8; 11x(9.3+7)x70= 12551; or 20x(9.3+7)x15.8= 5150.8? In this case the combination with the greatest probability is 11x(9.3+7)x70= 12551, which corresponds T_2 with C_1 or C_2 and L_1. So, T_2 is selected as the next bit in the bit hierarchy key. This procedure is repeated for all the differential probabilities until the entire key is found.

Alternately, the bit hierarchy key can be just some arbitrary sequence of the bits. It is also possible to make the priority vectors interdependent, such as making the length priority vector dependent on different groups of channels. Another technique is to make the bit hierarchy key 120 and the priority vector tables 122, a function of clock 42, as shown in FIG. 7. This makes it very difficult for the key and therefore the coding technique to be duplicated or copied.

For example it is possible to scramble the date bits in the bit hierarchy key 120 as a function of the clock. This would not change the effectiveness of the bit hierarchy key in reducing the number of binary bits for the most popular programs, because the date bits all are of equal priority. This could be as simple as

switching the D_1 and D_5 bits periodically, such as every day or week. Thus the bit hierarchy key 120 would switch between

$$\cdots \; C_1 \; T_1 \; L_1 \; D_5 \; D_4 \; D_3 \; D_2 \; D_1 \quad \text{and}$$

$$\cdots \; C_1 \; T_1 \; L_1 \; D_1 \; D_4 \; D_3 \; D_2 \; D_5.$$

Clearly other permutations of the bit hierarchy key as a function of the clock are possible.

The priority vector tables could also be scrambled as a function of the clock. For example, the first two channels in the priority channel table could just be swapped periodically. If this technique is followed, then the C_p of 148 in FIG. 7 would change as a function of the clock 42. For example,

channel	4	7	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

would change periodically to:

channel	7	4	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

This would be a fairly subtle security technique, because a decoder that was otherwise correct would only fail if those first two channels were being used. Other clock dependencies are also possible to provide security for the coding technique.

However it is derived, the bit hierarchy key 120 is determined and stored. In step 154 the binary bits of C_p, D_p, T_p, L_p are rearranged according to the bit hierarchy key 120 to create one 22 bit binary number. Then the resulting 22 bit

binary number is converted to decimal in the convert binary number to decimal G-code step 156. The result is G-code 158.

If the priority vector and the bit hierarchy key are well matched to the viewing habits of the general population, then it is expected that the more popular programs would require no more than 3 or 4 digits for the G-code.

Now that the encoding technique has been explained the decoding technique is just reversing the coding technique. This is done according to the flow chart of FIG. 6. This is the preferred G-code decoding that can be built into G-code decoder 38 in VCR 14 or the remote controller G-code decoders 82 and 92 in FIGs. 3 and 5.

The first step 102 is to enter G-code 104. Next the G-code 104 is converted to a 22 bit binary number in step 106. Then the bits are reordered in step 108 according to the bit hierarchy key 120 to obtain the reordered bits 110. Then the bits are grouped together and converted to decimal form in step 112. At this point we obtain C_p, D_p, T_p, L_p data 114, which are the indices to the priority vector tables. For the above example, we would have at this step the vector 4 9 1 3. This C_p, D_p, T_p, L_p data 114 is then used in step 116 to lookup channel, date, time, and length in priority vector storage 122. The CDTL 118 for the example above is 5 10 19.00 1.5, which means channel 5, 10th day of the month, 7:00 PM, and 1.5 hours in length.

If the coding technique is a function of the clock then it is also necessary to make the decoding technique a function of the clock. It is possible to make the bit hierarchy key 120 and the priority vector tables 122, a function of clock 42, as shown in FIG. 6. This again makes it very difficult for the key and therefore the coding technique to be duplicated or copied. It is

also possible to have the decoding and encoding techniques dependent on any other predetermined or preprogrammable algorithm.

Although the above G-code encoding and decoding technique is a preferred embodiment, it should be understood that there are many ways to perform the intent of the invention which is to reduce the number of keystrokes required for timer preprogramming. To accomplish this goal there are many ways to perform the G-code encoding and decoding. There are also many ways to make the encoding and decoding technique more secure besides just making the encoding and decoding a function of the clock. This security can be the result of any predetermined or preprogrammed algorithm.

It is possible in the G-code coding and decoding techniques to use mixed radix number systems instead of binary numbers. For example, suppose that there are only 35 channels, which would require 6 binary bits to be represented; however, 6 binary bits can represent 64 channels, because $2^6 = 64$. The result is that in a binary number system there are 29 unnecessary positions. This can have the effect of possibly making a particular G-code longer than it really needs to be. A mixed radix number system can avoid this result. For example, for the case of 35 channels, a mixed radix number system with the factors of 7^1 and 5^0 can represent 35 combinations without any empty space in the code. The allowed numbers for the 7^1 factor are 0, 1, 2, 3, and 4. The allowed numbers for the 5^0 factor are 0, 1, 2, 3, 4, 5, and 6. For example, digital 0 is represented in the mixed radix number system as 00. The digital number 34 is represented in the mixed radix number system as 46, because $4*7^1+6*5^0 = 34$. The major advantage of a mixed radix number system is in prioritizing the hierarchy key. If the first 5 channels have about equal priority and the next 30 are also about equal, then the mixed radix number

system allows the two tiers to be accurately represented. This is not to say that a mixed radix number system is necessarily preferable. Binary numbers are easier to represent in a computer and use of a fixed radix number system such as binary numbers allows a pyramid of prioritization to be easily represented in the hierarchy key.

Another feature that is desirable in all of the embodiments is the capability to key in the G-code once for a program and then have the resulting CDTL information used daily or weekly. Ordinarily the CDTL information is discarded once it is used. In the case of daily or weekly recording of the same program, the CDTL information is stored and used until it is cancelled. The desire to repeat the program daily or weekly can be performed by having a "WEEKLY" or "DAILY" button on the remote controller or built into the VCR manual controls. Another way is to use one key, such as the PROG key and push it multiple times within a certain period of time such as twice to specify daily or thrice to specify weekly. For example, if the G-code switch is "ON" and the G-code for the desired program is 99 then daily recording of the program can be selected by the following keystrokes:

"PROG 99 DAILY PROG"

or by:

"PROG 99 PROG P ROG".

The G-code 99 would be converted to CDTL information, which would be stored and used daily in this case. The recording would begin on the date specified and continue daily after that using the same channel time and length information. A slight twist is that daily recording could be automatically suspended during the weekends, because most daily programs are different on Saturday and Sunday.

Once a daily or weekly program is set up, then it can be used indefinitely. If it is desired to cancel a program and if

there is a "CANCEL" button on the remote controller or manual control for the VCR, then one way to cancel a program (whether it is a normal CDTL, daily or weekly entry) is to key in the following:

"PROG xx CANCEL", where xx is the G-code.

Again as before there are alternate ways of accomplishing this.

If "on screen programming" is available, then the programs that have been selected for timer preprogramming could be revieved on the screen. The daily and weekly programs would have an indication of their type. Also the G-codes could be displayed along with the corresponding CDTL information. This would make it quite easy to review the current "menu" and either add more programs or cancel programs as desired.

A television calendar 200 according to this invention is illustrated in FIG. 8. As shown, the television calendar has multiple day of year sections 202, multiple day sections 204, multiple time of day sections 206, channel indications 208, and descriptive program indications 210 arranged in a manner that is common in television guide publications. Arranged in relation to each channel indication is a compressed code 212 or G-code containing the channel, date, time and length information for that entry in the television calendar. FIG. 8 shows how easy it is to perform timer programming. All one needs to do is find the program one wants to watch and enter the compressed code. This is in contrast to having to deal with all the channel, date, time and length entries separately. At least the channel, date and time are explicitly stated in the television guide. The length is usually only available by searching the guide to find the time of day section 204 where a new program begins and then performing some arithmetic to find the length of the program. Using the compressed G-code avoids all these complications.

For cable television programs, there is an additional issue that needs to be addressed for the compressed G-code to be useful. In a normal television guide, CDTL information is available for all the normal broadcast channels in the form of numbers including the channel numbers, such as channel 4 or 7. However, for cable channels like HBO, ESPN etc., only the names of the channels are provided in most television listings. The reason for this is that in some metropolitan areas, such as Los Angeles, there may be only one (1) edition of television guide, but there may be quite a few cable carriers, each of which may assign HBO or ESPN to different cable channel numbers. In order for a compressed code such as the G-code to be applicable to the cable channels as published by a wide area television guide publication, the following approach can be used.

First, all the cable channels would be permanently assigned a unique number, which would be valid across the nation. For example, we could assign ESPN to cable channel 1, HBO as cable channel 2, SHO as cable channel 3, etc. This assignment would be published by the television guide publications.

The video cassette recorder apparatus, such as the remote controller, the VCR unit or both, could then be provided with two (2) extra modes: "set" and "cable channel". One way of providing the user interface to these modes would be to provide two (2) extra buttons: one called SET and one called CABLE CHANNEL. The buttons could be located on the video cassette recorder unit itself or located on a remote controller, as shown in FIGs 1, 3 and 5, where SET is element 168 and CABLE CHANNEL is element 170. Of course, other user interfaces are possible.

Next, the television viewer would have to go through a one-time "setting" procedure of his VCR for all the cable channels that he would likely watch. This "setting" procedure would

relate each of the assigned numbers for each cable channel to the channel number of the local cable carrier. For example, suppose that the local cable carrier uses channel 6 for ESPN, then cable channel number 1 could be assigned to ESPN, as shown in the following table.

Cable Channel Name	Assigned Cable Chan. No.	Channel Number in the local cable carrier
EPSN	1	6
HBO	2	24
SHO	3	23
.	.	.
.	.	.
.	.	.
DIS	8	25

The user could perform the "setting" procedure by pushing the buttons on his remote controller as follows:

SET 06 CABLE CHANNEL 1 PROGRAM
SET 24 CABLE CHANNEL 2 PROGRAM
SET 23 CABLE CHANNEL 3 PROGRAM
SET 25 CABLE CHANNEL 8 PROGRAM

The "setting" procedure would create a cable channel address table 162, which would be loaded into RAM 52 of command controller 36. For the above example, the cable channel address table 162 would have the following information.

CABLE CHANNEL ADDRESS TABLE 162

1 6

2 24
3 23
.
.
.
8 25

After the "setting" procedure is performed, the TV viewer can now select cable channels for viewing by the old way: eg. pushing the key pad buttons 24 will select HBO. He can also do it the new way: eg. by pushing CABLE CHANNEL 2, which will also select HBO. The advantage of the new way is that the television guide will publish [C2] next to the program description, so the viewer will just look up the assigned channel number instead of having to remember that HBO is local cable channel 24. When the CABLE CHANNEL button is pushed, command controller 36 knows that it will look up the local cable channel number in cable channel address table 162 to tune the VCR to the correct channel.

For timer preprogramming and for using the compressed G-code, a way to differentiate between broadcast and cable channels is to add an eighth channel bit, which would be set to 0 for normal broadcast channels and 1 for cable channels such as HBO. This eighth channel bit could be one of the low order bits such as the third bit C_3 out of the eight channel bits, so that the number of bits to specify popular channels is minimized, whether they be normal broadcast or cable channels. For a normal broadcast channel, the 7 other bits can be decoded according to priority vector C table 124. For a cable channel, the 7 other bits can be decoded according to a separate cable channel priority vector table 160, which could be stored in ROM 54 of microcontroller 36. The cable channel priority vector table can be set ahead of time for the entire country or at least for an

area covered by a particular wide area television guide publication.

A television guide that carries the compressed code known as the G-code will now print the cable channel information as follows:

6:30 pm
(C2) HBO xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx (4679)
xxxxxx(program description)xxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

The (C2) in front of HBO reminds the viewer that he needs only to push CABLE CHANNEL 2 to select HBO. The (4679) is the G-code for this particular program.

FIG. 8 shows a section of a television guide. The cable channels all have an assigned cable channel number 188 after the cable channel mnemonic. Other than that the cable channel information is arranged the same as the broadcast channels with a compressed G-code 212 associated with the channel.

For timer preprogramming, the viewer need only enter the number 4679 according to the unit's G-code entry procedure, eg. PROG 4679 PROG. The G-code decoder unit will decode this G-code into "cable channel 2" and will also signal the command controller 36 with a cable channel signal 164, as shown in FIGs. 1 and 2, because the extra channel bit will be "1" which distinguishes that the G-code is for a cable channel; then, since the association of "cable channel 2" with channel 24 has been established earlier in the "setting" procedure, the command controller, if it has received a cable channel signal, will immediately look up 2 in the cable channel address table 162 to translate it to cable channel 24, which will be used as the

recording channel at the appropriate time. By associating the G-code with the assigned cable channel number rather than the local cable channel number, the G-code for that program will be valid in the whole local area, which may have many different cable carriers each of which may have different local cable channel numbers.

To include the cable channel compressed G-code feature, the decoding and encoding algorithms are as shown in FIGs 9 and 10, respectively. The encoding should be explained first before the decoding. The primary change in FIG. 10 from FIG. 7 is that a cable channel priority vector table 160 has been added and is used in look up priority step 180 if a cable channel is being encoded. Also if a cable channel is being encoded then the cable channel bit is added in the correct bit position in the convert $C_pD_pT_pL_p$ to binary numbers step 182. This could be bit C_3, as discussed before. The bit hierarchy key could be determined as before to compress the number of bits in the most popular programs; however, it needs to be 23 bits long to accommodate the cable channel bit. The maximum compressed G-code length could still be 7 digits, because 2^{23}= 8,388,608.

The decoding is shown in FIG. 9 and is just the reverse of the encoding process. After step 108, test cable channel bit 174 is added and effectively tests the cable channel bit to determine if it is a "1". If so then the command controller 36 is signaled via cable channel signal 164 of FIGs. 1 and 2 that the CDTL 118 that will be sent to it from G-code decoder 38 is for a cable channel. Then the command controller knows to look up the local cable carrier channel number based on the assigned cable channel number. In step 176 of FIG. 9, the priority vector tables including the cable channel priority vector table 160 are used to look up the CDTL 118 information.

An alternate to having the command controller receive a cable channel signal 164 is for the G-code decoder to perform all of the decoding including the conversion from assigned cable channel number to local cable carrier number. This would be the case for the remote controller implementation of FIG. 3. FIG. 11 shows the implementation of the entire decode algorithm if this step is included. All that needs to added is convert assigned channel to local cable carrier channel step 166, which performs a lookup in cable channel address table 162, if the cable channel bit indicates that a cable channel is involved. Step 166 effectively replaces step 174 in FIG. 9.

Another issue that needs addressing is the number of programs that can be preprogrammed. Since the G-code greatly simplifies the process of entering programs, it is likely that the user will quickly learn and want to enter a large number of programs; however, some existing VCRs can only store up to four (4) programs, while some can store as many as eight. Thus, the user may get easily frustrated by the programming limitations of the VCR.

One approach to this problem, is to perform the compressed G-code decoding in the remote controller and provide enough memory there to store a large number of programs, eg. 20 or 40. The remote controller would have the capability of transferring periodically several of these stored programs at a time to the VCR main unit. To provide this capability, extra memory called stack memory 76 is required inside the remote unit, as shown in Fig. 12, which other than that is identical to FIG. 4. Stack memory 76 can be implemented with a random access memory, which may in fact reside in the microcontroller itself, such as RAM 62.

The stack memory 76 is where new entry, insertion & deletion of timer preprogramming information is carried out. It is also

where editing takes place. The top memory locations of the stack, for example the first 4 locations, correspond exactly to the available timer preprogramming memory in the VCR main unit. Whenever the top of the stack memory is changed, the new information will be sent over to the VCR main unit to update it.

FIG. 13 shows the sequence of events when the user enters a G-code program on the keypad of the remote controller. For illustration purposes, suppose the VCR main unit can only handle four (4) programs. Suppose also that the stack memory capacity is 20 timer preprograms. Referring to the flow chart in FIG.13, when the user enters a G-code in step 230, the microcontroller 60 first decodes it into the CDTL information in step 234 and displays it on the display unit with the additional word "entered" also displayed. The microcontroller then enters the decoded program into the stack memory in step 236.

If this is the first program entered, it is placed at the top location of the stack memory. If there are already programs in the stack memory, the newly entered program will first be provisionally placed at the bottom of the stack memory. The stack memory will then be sorted into the correct temporal order in step 240, so that the earliest program in time will appear in the top location and the last program in time will be at the bottom. Notice that the nature of the temporally sorted stack memory is such that if stack memory location n is altered, then all the locations below it will be altered.

For example, suppose the stack memory has six (6) entries already temporally ordered, and a new entry is entered whose temporal ordering places it in location 3 (1 being the top location). If this entry is placed into location 3, information which was in location 3, 4, 5, 6 will be shifted to locations 4, 5, 6, and 7. Locations 1 and 2 will remain unchanged.

The microcontroller 60, after doing the temporal ordering, checks in step 242 whether the first n entries have changed from before, where for the current example n equals 4. In this case, since a new program has been entered into location 3, what used to be in location 3 now moves to location 4. Since the VCR's main unit program menu of 4 entries should correspond exactly to location 1 through 4 of the stack memory, entries 3 and 4 on the VCR main unit must now be revised. The microcontroller therefore sends out the new entries 3 & 4 to the main unit, in step 244 of FIG. 13. If the newly entered program, after temporal ordering, gets entered into location 5, then entries 1 through 4 have not changed from before and the microcontroller will not send any message to the VCR main unit and the microcontroller will just resume monitoring the clock 85 and the keyboard 88 as per step 246. It is assumed that when the user enters the G-code in step 230, the remote controller is pointed at the VCR main unit. The other steps of FIG. 13 happen so fast that the changes are sent in step 244 while the remote controller is still being pointed at the VCR main unit.

If the user decides to delete a program in step 232, the deletion is first carried out in the stack memory. If the first 4 entries are affected, the microcontroller will send the revised information over to the VCR main unit. If the first 4 entries are not affected, then again the remote controller unit will not send anything. The deletion will only change the lower part of the stack (lower meaning location 5 to 20). This new information will be sent over to the VCR main unit at the appropriate time.

In the meantime, the VCR main unit will be carrying out its timer programming function, completing its timing preprogramming entries one by one. By the time all 4 recording entries have been completed, the stack in the remote must send some new

entries over to "replenish" the VCR main unit (if the stack has more than 4 entries).

The real time clock 85 in the remote controller unit is monitored by the microcontroller to determine when the programs in the main unit have been used up. Referring to the flow chart in FIG. 14, the microcontroller periodically checks the clock and the times for the programs at the top of the stack in step 250 (say the first 4 entries), which are identical to the VCR's main unit's menu. If on one of the periodic checks, it is determined that the recording of the main unit's menu is complete, then if there are more entries in the stack, which is tested in step 252, the display unit will be set to a blinking mode or display a blinking message in step 258 to alert the user to send more programs. Next time the user picks up the remote unit, the blinking will remind him that the VCR main unit's program menu has been completed and it is time to replenish the VCR main unit with program entries stored in the remote. The user simply picks up the remote and points it towards the VCR main unit and presses "ENTER". This will "pop" the top of the stack memory in step 260, ie. pop all the entries in the stack up by four locations. The microcontroller will then send the new "top of the stack" (ie. top 4 entries) over to the VCR main unit in step 262. This process will repeat until the whole stack has been emptied.

It is thought that the apparatus and method for using encoded video recorder/player timer preprogramming information of the present invention and many of its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the parts thereof without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore

described being merely a preferred or exemplary embodiment thereof.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A recorder using compressed codes for recorder timer preprogramming that comprises:

means for entering and transmitting a compressed code having at least one digit;

means for receiving a command signal coupled to said means for entering and transmitting a compressed code having at least one digit;

means for command control for interpreting that a received signal is a compressed code having at least one digit and for controlling a recorder, electrically coupled to said means for receiving a command signal;

a means for keeping time electrically coupled to said means for command control;

means for decoding a compressed code having at least one digit into channel, date, time and length information electrically coupled to said means for command control;

means for recording and playback;

means for turning said means for recording and playback on and off in response to said date, time and length information; and

means for tuning channels electrically coupled to a signal input and to said means for recording and playback and to said means for command control and responsive to said channel information.

2. The recorder using compressed codes for recorder timer preprogramming of claim 1 wherein:

said means for keeping time is electrically coupled to said means for decoding a compressed code having at least one digit into channel, date, time and length information; and

wherein the decoding of a compressed code by said means for decoding a compressed code into channel, date, time and length information is a function of the time of said means for keeping time.

3. The recorder using compressed codes for recorder timer preprogramming of claim 2 which further comprises:

means coupled to said means for command control for daily using said channel, date, time and length (CDTL) information decoded from said compressed code having at least one digit wherein the start date is the date specified in said channel, date, time and length (CDTL) information for recording a program daily.

4. The recorder using compressed codes for recorder timer preprogramming of claim 2 which further comprises:

means coupled to said means for command control for weekly using said channel, date, time and length (CDTL) information decoded from said compressed code having at least one digit wherein the start date is the date specified in said channel, date, time and length (CDTL) information for recording a program weekly.

5. The recorder using compressed codes for recorder timer preprogramming of claim 2 wherein said means for entering and transmitting a compressed code having at least one digit comprises:

means for remote control having a signal transmit means coupled to said means for command control receiver; and

means for entering a compressed code having at least one digit electrically coupled to said means for remote control.

6. The apparatus for using encoded video recorder/player timer preprogramming information of claim 2 wherein said means for entering and transmitting a compressed code comprises:

means for manual control electrically coupled to said means for a command signal receiver; and

means for compressed code entry means electrically coupled to said means for manual control.

7. A recorder using compressed codes for recorder timer preprogramming that comprises:

means for remote control having a means for transmitting signals;

means for entering a compressed code having at least one digit electrically coupled to said means for remote control;

means for decoding a compressed code having at least one digit into channel, date, time and length information electrically coupled to said means for remote control;

means for receiving a command signal coupled to said means for transmitting signals on said means for remote control;

means for command control for controlling a recorder electrically coupled to said means for receiving a command signal;

a first means for keeping time electrically coupled to said means for command control;

means for recording and playback;

means for turning said means for recording and playback on and off in response to said date, time and length information

sent from said means for remote control to said means for command control; and

means for tuning channels electrically coupled to a signal input and to said means for recording and playback and to said means for command control and responsive to said channel information sent from said means for remote control to said means for command control.

8. The recorder using compressed codes for recorder timer preprogramming of claim 7 that further comprises:

a second means for keeping time electrically coupled to said means for decoding a compressed code having at least one digit into channel, date, time and length information;

wherein the decoding of a compressed code by said means for decoding a compressed code into channel, date, time and length information is a function of the time of said second means for keeping time.

9. The recorder using compressed codes for recorder timer preprogramming of claim 8 which further comprises:

means coupled to said command controller for daily using said channel, date, time and length (CDTL) information decoded from said compressed code having at least one digit wherein the start date is the date specified in said channel, date, time and length (CDTL) information for recording a program daily.

10. The recorder using compressed codes for recorder timer preprogramming of claim 8 which further comprises:

means coupled to said command controller for weekly using said channel, date, time and length (CDTL) information decoded from said compressed code having at least one digit wherein the

start date is the date specified in said channel, date, time and length (CDTL) information for recording a program weekly.

11. A recorder using compressed codes for recorder timer preprogramming that comprises:

means for universal remote control having a means for transmitting signals and a means for receiving signals;

a learn switch electrically coupled to said means for universal remote control wherein when said learn switch is "ON" said means for universal remote control can learn another remote controller functions via said means for receiving signals;

means entering a compressed code having at least one digit electrically coupled to said means for universal remote control;

means for decoding a compressed code having at least one digit into channel, date, time and length information electrically coupled to said means for universal remote control;

means for receiving a command signal coupled to said means for transmitting signals on said universal remote control;

means for command control for controlling a recorder electrically coupled to said means for receiving a command signal;

a first means for keeping time electrically coupled to said means for command control;

means for recording and playback;

means for turning said means for recording and playback on and off in response to said date, time and length information sent from said means for remote control to said means for command control; and

means for tuning channels electrically coupled to a signal input and to said means for recording and playback and to said means for command control and responsive to said channel information sent from said means for remote control to said means for command control.

12. The recorder using compressed codes for recorder timer preprogramming of claim 11 that further comprises:

a second means for keeping time electrically coupled to said means for decoding a compressed code having at least one digit into channel, date, time and length information; and

wherein the decoding of a compressed code by said means for decoding a compressed code into channel, date, time and length information is a function of the time of said second means for keeping time.

13. The recorder using compressed codes for recorder timer preprogramming of claim 12 which further comprises:

means coupled to said command controller for daily using said channel, date, time and length (CDTL) information decoded from said compressed code having at least one digit wherein the start date is the date specified in said channel, date, time and length (CDTL) information for recording a program daily.

14. The recorder using compressed codes for recorder timer preprogramming of claim 12 which further comprises:

means coupled to said command controller for weekly using said channel, date, time and length (CDTL) information decoded from said compressed code having at least one digit wherein the start date is the date specified in said channel, date, time and length (CDTL) information for recording a program weekly.

15. A method for using compressed codes for recorder timer preprogramming comprising the steps of:

providing a program guide wherein each program description has a compressed code of at least one digit associated with said program description representing the channel, date, time and length of the program;

providing a means for entering a compressed code of at least one digit to perform timer preprogramming for each selected program;

providing a means for decoding a compressed code;

decoding said compressed code of at least one digit into channel, date, time and length information;

providing a clock means for keeping time;

comparing said date, time and length information to said clock means;

providing a means for tuning channels;

tuning said means for tuning channels to the channel indicated by said channel information when said clock means compares with said date and time information;

providing a means for recording and playback;

turning said means for record and playback on for record when said clock means compares with said date and time information; and

turning said means for recording and playback means off for record when said length information matches time of recording on said clock means.

16. The method for using compressed codes for recorder timer preprogramming of claim 15 wherein the step of decoding said compressed code of at least one digit into channel, date, time and length information further comprises the steps of:

converting said compressed code of at least one digit into a compressed code of binary bits;

providing a bit hierarchy key that specifies the reordering of said compressed code of binary bits;

reordering all the bits in said compressed code of binary bits according to said bit hierarchy key to obtain a reordered binary compressed code;

separating said reordered binary compressed code into binary channel, date, time and length priority indices;

providing priority vectors for channel, date, time and length; and

using said channel, date, time and length priority indices to lookup channel, date, time and length information from said priority vectors for channel, date, time and length, respectively.

17. The method for using compressed codes for recorder timer preprogramming of claim 16 wherein the step of decoding said compressed code of at least one digit into channel date time and length information further comprises the steps of:

providing a plurality of bit hierarchy keys; and

selecting one of said plurality of bit hierarchy keys for use as a function of the time of said clock means.

18. The method for using compressed codes for recorder timer preprogramming of claim 16 wherein the step of decoding said compressed code of at least one digit into channel date time and length information further comprises the steps of:

providing multiple sets of priority vectors for channel, date, time and length; and

selecting one of said multiple sets of priority vectors for channel, date, time and length for use as a function of the time of said clock means.

19. The method for using compressed codes for recorder timer preprogramming of claim 16 which further comprises the steps of:

providing a means for daily comparing said clock means to the channel, time and length information in said channel, date, time and length information starting on the date specified in said channel, date, time and length information;

tuning said means for tuning channels to the channel indicated by said channel information when said clock means compares with said time information;

turning on recording for said means for recording and playback when said clock means compares with said time information; and

turning off recording for said means for recording and playback when said length information matches time of recording on said clock means.

20. The method for using compressed codes for recorder timer preprogramming of claim 16 which further comprises the steps of:

providing a means for comparing weekly said clock means to the channel, time and length information in said channel, date, time and length information starting on the date specified in said channel, date, time and length information;

tuning said means for tuning channels to the channel indicated by said channel information when said clock means is compared weekly and compares with said time information;

turning on recording for said means for recording and playback when said clock means is compared weekly and compares with said time information; and

turning off recording for said means for recording and playback when said length information matches time of recording on said clock means.

21. The method of using encoded video recorder/player timer preprogramming information of claim 15 wherein the step of decoding said compressed code of one to many digits into channel date time and length information further comprises the step of:

periodically using different algorithms for decoding said compressed code of one to many digits into channel date time and length information.

22. The method of using encoded video recorder/player timer preprogramming information of claim 15 wherein the step of decoding said compressed code of one to many digits into channel date time and length information further comprises the steps of:

converting said compressed code of one to many digits into a compressed mixed radix number code;

providing a hierarchy key that specifies the reordering of said compressed mixed radix number code;

reordering all the numbers in said compressed mixed radix code according to said hierarchy key to obtain a reordered compressed mixed radix code;

separating said compressed mixed radix code into channel, date, time and length priority indices;

providing priority vectors for channel, date, time and length; and

using said channel, date, time and length priority indices to lookup channel, date, time and length information from said priority vectors for channel, date, time and length.

23. A method of encoding a set of codes to represent a multidimensional vector to minimize the length of codes which are most often used based on the relative probabilities of the values in each dimension in order to assist in making it easier to

select multidimensional vectors for commercial or industrial applications comprising the steps of:

entering an input value for each dimension of the multidimensional vector;

providing a priority vector table for each dimension of the multidimensional vector wherein the priority vector table for each dimension lists every possible value in the dimension in the order of its relative priority and assigns a unique priority number to every possible value;

performing a table lookup in said priority vector table on said input value for each dimension to find its unique priority numbers;

converting each said unique priority number for said input value for each dimension to a binary number and concatenating the resulting binary numbers to form one long binary number;

providing a binary bit hierarchy key arranged in the order of highest differential probability to least differential probability of the combination of bits representing all the dimensions of the multidimensional vector, wherein the differential probability is a measure of the relative importance of a bit from one dimension over a bit from another dimension in minimizing the length of codes which are most often used;

reordering all bits in said one long binary number according to the order of said binary bit hierarchy key to form a compressed code; and

using said compressed code to select multidimensional vectors for commercial or industrial applications.

24. The method of claim 23 wherein the step of reordering all bits in said one long binary number according to the order of said binary bit hierarchy key further comprises the step of converting the resulting binary number to decimal.

25. The method of claim 23 wherein the step of providing a binary bit hierarchy key arranged in the order of highest differential probability to least differential probability of the combination of bits representing all the dimensions of the multidimensional vector, wherein the differential probability is a measure of the relative importance of a bit from one dimension over a bit from another dimension in minimizing the length of codes which are most often used further comprises interchanging some of the bits on a periodic basis for security reasons.

26. The method of claim 23 wherein the step of using the resulting compressed code to select multidimensional vectors for commercial or industrial applications further comprises:

decoding the compressed code into its original input values for each dimension of the multidimensional vector.

27. The method of claim 26 wherein the step of decoding the compressed code into its original input values for each dimension of the multidimensional vector further comprises:

providing a binary bit hierarchy key arranged in the order of highest differential probability to least differential probability of the combination of bits representing all the dimensions of the multidimensional vector, wherein the differential probability is a measure of the relative importance of a bit from one dimension over a bit from another dimension in minimizing the length of codes which are most often used;

reversing the step of reordering all bits in said one long binary number according to the order of said binary bit hierarchy key;

grouping the reordered bits into those belonging to each dimension and converting the resulting binary numbers to decimal priority numbers;

providing a priority vector table for each dimension of the multidimensional vector wherein the priority vector table for each dimension lists every possible value in the dimension in the order of its relative priority and assigns a unique priority number to every possible value; and

looking up a value for each dimension of the multidimensional vector in each said priority vector table by using said decimal priority numbers as an index to each said priority vector table.

28. A method of encoding a set of codes to represent a multidimensional vector to minimize the length of codes which are most often used based on the relative probabilities of the values in each dimension in order to assist in making it easier to select multidimensional vectors for commercial or industrial applications comprising the steps of:

entering an input value for each dimension of the multidimensional vector;

providing a priority vector table for each dimension of the multidimensional vector wherein the priority vector table for each dimension lists every possible value in the dimension in the order of its relative priority and assigns a unique priority number to every possible value;

performing a table lookup in said priority vector table on said input value for each dimension to find its unique priority numbers and concatenating these unique priority numbers into one number; and

using the resulting code to select multidimensional vectors for commercial or industrial applications.

29. A television calendar for combined visual selection of programs for direct viewing and for use in automatic recording of programs for future viewing, the combination comprising:

a day section and positioned in relation therewith an associated unique day visual identifier, for each of a plurality of calendar days;

a time-of-day section and positioned in relation therewith an associated unique time-of-day visual identifier, within each day section, for each of a plurality of television program starting times;

a plurality of unique channel visual indications and corresponding to each such channel visual indication, a descriptive program indication within each time-of-day section for each television program that starts at the time of such time-of-day section; and

an additional unique coded indication for the start of each said television program positioned in a predetermined relation to each said channel visual indication, the coded indication representing the channel corresponding to said channel visual indication for said television program, the time of day corresponding to said time-of-day visual indication for said time-of-day section for said television program, the calendar day corresponding said day visual identifier for said day section in which said television program appears, and the length of time for said television program.

30. A television calendar on a display medium for combined visual selection of programs for direct viewing and for automatically programming a video recorder for time-shifted viewing, the combination comprising:

a day-of-year section for each of a plurality of calendar days, the day-of-year sections being ordered sequentially on the display medium by calendar day and each of the day-of-year sections being positioned in relation to a unique day-of-year visual indicator on the display medium;

a time-of day section for each of a plurality of television program starting times within a calendar day, the time-of-day sections being ordered sequentially on the display medium by time within each day-of-year section and each of the time-of-day sections being positioned in relation to a unique time-of-day visual indicator on the display medium;

a plurality of unique channel indications on the display medium within each of the time-of-day sections, each channel indication further being positioned corresponding to a descriptive program indication for each television program that begins at the starting time indicated by the time-of-day section; and

a plurality of unique coded indications, each corresponding to and positioned on the display medium in relation to a unique channel indication and its corresponding descriptive program indication, each of the unique coded indications representing a unique television channel represented by the channel indications, the time of day represented by the time-of-day indications for the corresponding time-of-day section, the calendar day represented by the day-of-year indications for the corresponding day-of-year section, and the duration of the corresponding television program.

31. A method of creating a television calendar for combined visual selection of programs for direct viewing and for use in automatic recording of programs for future viewing, comprising the steps of:

providing a coded date visual identifier representing the date on which the television program will be broadcasted;

providing a coded time-of-day visual identifier representing the time that the program will be broadcasted;

providing a coded channel visual identifier representing the channel of the program; and

providing a coded length visual identifier representing the duration of the program.

32. A system for the automatic recording of a television program on a video recorder comprising:

a television calendar listing television programs by the date and time of each program and the television channel on which each program is to appear, the calendar having a unique compressed code indication corresponding to the start of each different listed program and representing the date and time the program is to start, the channel on which the program will appear, and the duration of the program; and

a controller for the video recorder for receiving representations of the compressed coded indications and for enabling such video recorder to commence recording television signals carrying the program on the channel, on the date, at the time and terminating after the duration represented by any of said compressed coded indications.

33. The system of claim 32 wherein the controller comprises:

input for receiving the representation of the compressed code indications;

a decoder for decoding the compressed code indications into corresponding channel, date, time and duration information;

a channel selector for selecting the channels identified in the compressed code indications decoded by said decoder; and

an on/off controller for enabling recording by the video recorder for a television program by activating said channel selector to select the corresponding channel as decoded for that television program and turning on the recording commencing at a date and a time as decoded for the television program and terminating recording after the duration decoded for the

television program represented by the same compressed coded indication that is decoded by the decoder.

34. A video cassette recorder controller for automatically enabling recording by a video cassette recorder of a channel of video signals specified by a coded channel signal beginning at the time of day specified by a coded time-of-day signal, on the calendar day specified by a coded day signal and for the length of time specified by a coded length signal, the improvements comprising:

an input for receiving a compressed coded signal representative of and compressed in length from, the combination of said coded channel, time-of-day, day and length signals; and

a decoder for decoding and expanding said compressed coded signal to said individual coded channel, time-of-day, day and length signals for control of such controller.

35. The video controller of claim 34 wherein the input and decoder are an integral part of the controller.

36. The video controller of claim 34 comprising a remote handheld transmitter comprising said input and decoder.

37. The video controller of claim 35 or 36 wherein the input comprises a keyboard entry device.

38. The video controller of claim 35 or 36 wherein the decoder comprises a microprocessor.

39. A method of programming a video cassette recorder controller for automatically enabling recording by a video cassette recorder of a channel of video signals specified by a coded channel signal beginning at the time of day specified by a coded time-of-day

signal, on the calendar day specified by a coded day signal and for the length of time specified by a coded length signal, the steps comprising:

receiving a compressed coded signal representative of and compressed in length from, the combination of said coded channel, time-of-day, day and length signals; and

decoding and expanding said compressed coded signal to said individual coded channel, time-of-day, day and length signals for control of such controller.

40. The method of claim 39 comprising the step of receiving the compressed coded signals in the controller.

41. The method of claim 39 comprising the step of receiving the compressed coded signal in a remote handheld transmitter.

42. The method of claim 40 or 41 wherein the step of receiving comprises the step of inputting the compressed coded signal through a keyboard entry device.

43. The method of claim 40 or 41 wherein the step of decoding comprises the step of decoding the compressed coded signal which comprises a microprocessor.

44. An apparatus for decoding television program information, including channel, date, time, and length of the program, for automatically recording television programs with a television said apparatus comprising:

means for entering encoded data into the apparatus;

means for decoding said encoded data to determine the date, time, channel and length of the program to be recorded; and

means for generating control signals from said encoded data for control of the video recorder to select the channel and to activate and stop the recording of the video recorder.

45. A method of using a set of codes to represent a multidimensional vector to minimize the length of codes which are most often used based on the relative probabilities of the values in each dimension in order to assist in making it easier to select multidimensional vectors for commercial or industrial applications comprising the steps of:

entering an input value for each dimension of the multidimensional vector;

providing a priority vector table for each dimension of the multidimensional vector wherein the priority vector table for each dimension lists every possible value in the dimension in the order of its relative priority and assigns a unique priority number to every possible value;

performing a table lookup in said priority vector table on said input value for each dimension to find its unique priority numbers;

converting each said unique priority number for said input value for each dimension to a number in a fixed or mixed radix system and concatenating the resulting numbers to form one long number;

providing a hierarchy key arranged in the order of highest differential probability to least differential probability of the combination of numbers representing all the dimensions of the multidimensional vector and all the radix positions within each number of fixed or mixed radix, wherein the differential probability is a measure of the relative importance of a radix position of a number from one dimension over a radix position of a number from another dimension in minimizing the length of codes which are most often used;

reordering all numbers in said one long number according to the order of said hierarchy key to form a compressed code; and

using said compressed code to select multidimensional vectors for commercial or industrial applications.

46. The method of claim 45 wherein the step of using the resulting compressed code to select multidimensional vectors for commercial or industrial applications further comprises:

decoding the compressed code into its original input values for each dimension of the multidimensional vector.

47. The method of claim 46 wherein the step of decoding the compressed code into its original input values for each dimension of the multidimensional vector further comprises:

providing a hierarchy key arranged in the order of highest differential probability to least differential probability of the combination of numbers representing all the dimensions of the multidimensional vector and all the radix positions within each number of fixed or mixed radix, wherein the differential probability is a measure of the relative importance of a radix position of a number from one dimension over a radix position of a number from another dimension in minimizing the length of codes which are most often used;

reversing the step of reordering all numbers in said one long number according to the order of said hierarchy key;

grouping the reordered numbers into those belonging to each dimension to form priority numbers;

providing a priority vector table for each dimension of the multidimensional vector wherein the priority vector table for each dimension lists every possible value in the dimension in the order of its relative priority and assigns a unique priority number to every possible value; and

looking up a value for each dimension of the multidimensional vector in each said priority vector table by using said priority numbers as an index to each said priority vector table.

48. A television calendar of claim 29, the combination further comprising:

a plurality of unique cable channel visual indications and corresponding to each such cable channel visual indication, a descriptive program indication within each time-of-day section for each cable television program that starts at the time of such time-of-day section; and

an assigned cable channel number positioned in a predetermined relation to each said cable channel visual indication, the assigned cable channel number representing the cable channel corresponding to said cable channel visual indication for said cable television program and being valid for a wide area spanning multiple local cable carriers.

49. A television calendar of claim 30, the combination further comprising:

a plurality of unique cable channel indications on the display medium within each of the time-of-day sections, each cable channel indication further being positioned corresponding to a descriptive program indication for each cable television program that begins at the starting time indicated by the time-of-day section; and

a plurality of assigned cable channel numbers, each corresponding to and positioned on the display medium in relation to a unique cable channel indication and its corresponding descriptive program indication, each of the assigned cable channel numbers representing a unique cable television channel

represented by the cable channel indications and being valid for a wide area spanning multiple local cable carriers.

50. The method of using encoded video recorder/player timer preprogramming information of claim 16 or 22 wherein the step of decoding said compressed code of one to many digits into channel date time and length information further comprises the step of:

testing whether said channel information is for an assigned cable channel and if so converting said channel information into local cable carrier channel information.

51. The method of controlling a television controller for selecting a cable channel for viewing, the steps comprising:

providing a television calendar with assigned cable channel numbers associated with each cable channel;

providing a television controller having a cable channel address table with memory for a set of assigned cable channel numbers and a corresponding set of local cable carrier channel numbers and having the capability to convert an assigned cable channel number into a local cable carrier channel number by using said cable channel address table;

setting up said cable channel address table with said set of assigned cable channel numbers and said corresponding set of local cable carrier channel numbers;

entering an assigned cable channel number corresponding to a cable channel selected for viewing; and

conversion of said assigned cable channel number into a corresponding local cable carrier channel number by said television controller.

52. The apparatus for using encoded video recorder/player timer preprogramming information of claim 1 wherein:

said means for decoding a compressed code into channel, date, time and length information electrically coupled to said means for command control further comprises a means for detecting that said channel information corresponds to an assigned cable channel number; and

said means for command control further comprises a means for converting an assigned cable channel number into a local cable carrier channel number.

53. The apparatus for using encoded video recorder/player timer preprogramming information of claim 7 or 11 wherein said means for decoding a compressed code into channel, date, time and length information electrically coupled to said means for remote control further comprises:

a means for detecting that said channel information corresponds to an assigned cable channel number; and

a means for converting an assigned cable channel number into a local cable carrier channel number.

54. The apparatus for using encoded video recorder/player timer preprogramming information for a recorder of claim 7 or 11 further coaprises:

a stack memory coupled to said means for decoding a compressed code for storing a plurality of programs consisting of channel, date, time and length information for timer preprogramming; and

a second means for keeping time electrically coupled to said means for decoding a compressed code into channel, date, time and length information.

55. The method of permitting a large number of programs to be timer preprogrammed for recording by a video cassette recorder for time shifted viewing where the video cassetter recorder can store only N timer preprogrammed programs, the steps comprising:

providing a remote controller having a means for keeping time;

entering into said remote controller compressed codes, each representative of, and compressed in length from, the combination of channel, time-of-day, day and length information for a program; and

decoding each compressed code to channel, time-of-day, day and length information;

providing a memory;

entering each said channel, time-of-day, day and length information into said memory;

reordering said channel, time-of-day, day and length information in said memory into temporal order; and

testing whether first N entries in said memory have changed and if yes, sending changed entries in first N entries to said video cassette recorder.

56. The method of permitting a large number of programs to be timer preprogrammed of claim 55, the steps further comprising:

periodically checking whether stop time of Nth entry of said first N entries in memory has passed; and

if stop time of Nth entry has passed and number of entries in memory is greater than N, then turning on a means for alerting a user to activate remote controller to send more programs to said video cassette recorder and once remote controller is activated, setting next N entries in said memory to be the first N entries in said memory and sending said first N entries to said video cassette recorder and turning off said means for alerting a user.

57. An apparatus for using encoded video recorder/player timer preprogramming information for a recorder that comprises:

means for remote control having a means for transmitting signals;

means for compressed code entry electrically coupled to said means for remote control;

means for decoding a compressed code into channel, date, time and length information electrically coupled to said means for remote control;

means for storing said channel, date, time and length information in said remote control;

a means for keeping time electrically coupled to said means for remote control;

means for command control electrically coupled to said means for remote control; and

wherein said means for command control compares the stored date, time and length information to said means for keeping track of time and sends at the appropriate time start record and stop record commands and channel select commands to a VCR unit via said transmit signals from said means for remote control.

58. The apparatus for using encoded video recorder/player timer preprogramming information for a recorder of claim 57 that further comprises:

means for storing a plurality of sets of transmit signals for different VCR models commands electrically coupled to said means for remote control; and

means for selecting for a particular VCR model a set of transmit signals for sending commands.

59. The apparatus for using encoded video recorder/player timer preprogramming information for a recorder of claim 57 wherein:

said means for remote control is a universal remote controller and can learn a set of transmit signals for sending commands to a particular VCR.

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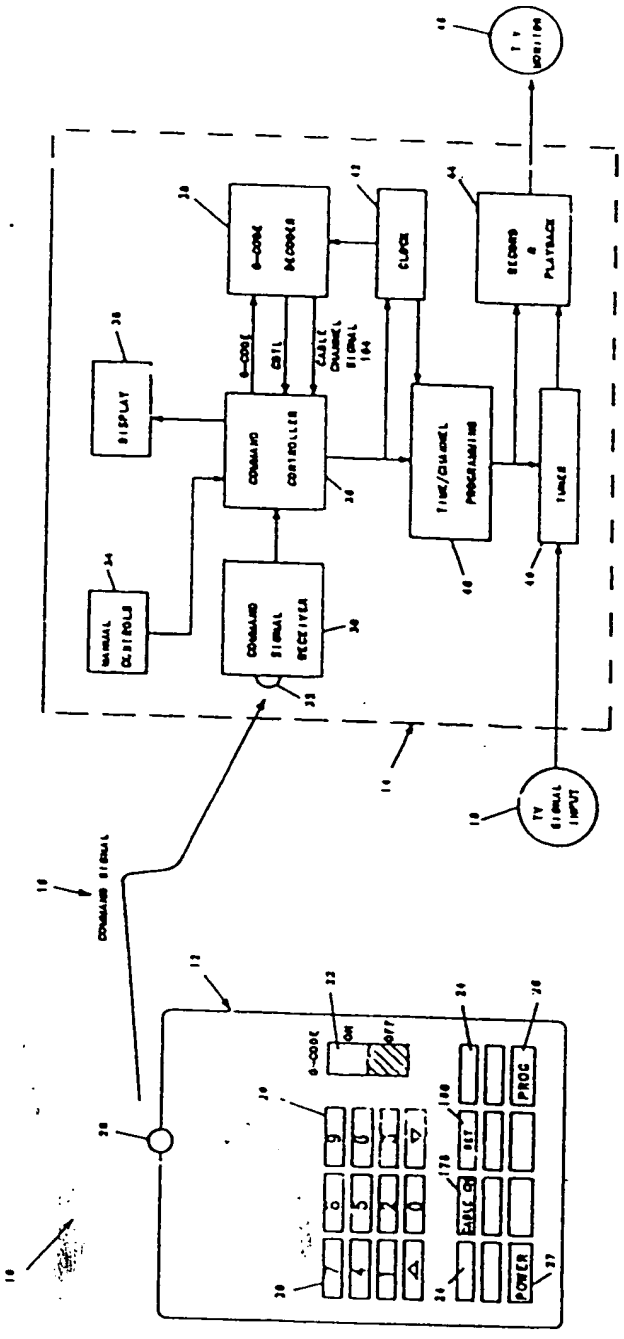

TV SIGNAL INPUT
CLOCK
RECORD & PLAYBACK
TIMER
TIME/CHANNEL PROGRAMMING
COMMAND CONTROLLER
DISPLAY
MANUAL CONTROLS
COMMAND SIGNAL RECEIVER
COMMAND SIGNAL
G-CODE
ON
OFF
PROG
RST
ERASE
POWER

FIG. 1

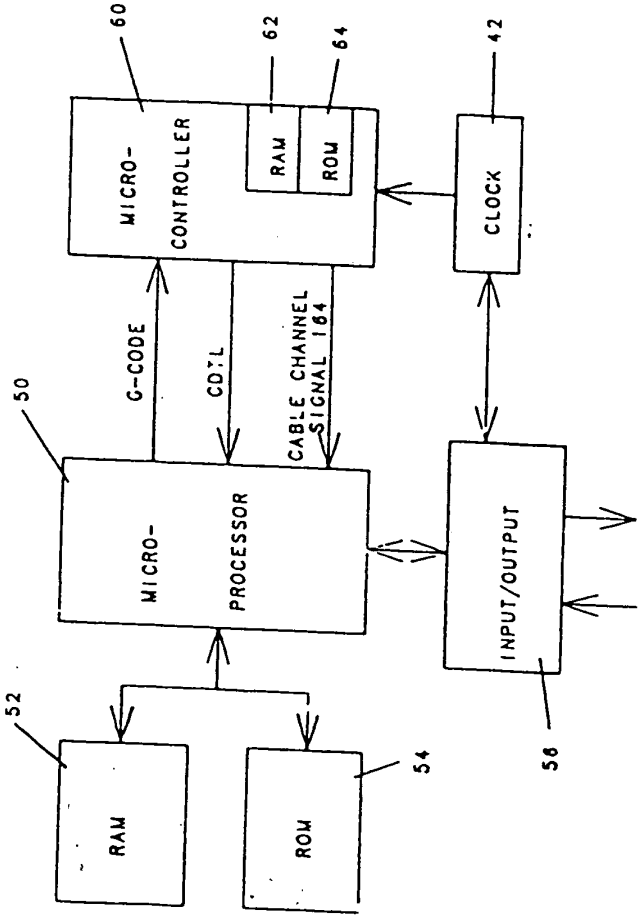

60
62
64
42
MICRO-
CONTROLLER
RAM
ROM
CLOCK
G-CODE
COIL
CABLE CHANNEL
SIGNAL 164
50
MICRO-
PROCESSOR
INPUT/OUTPUT
52
RAM
ROM
54
56

FIG.2

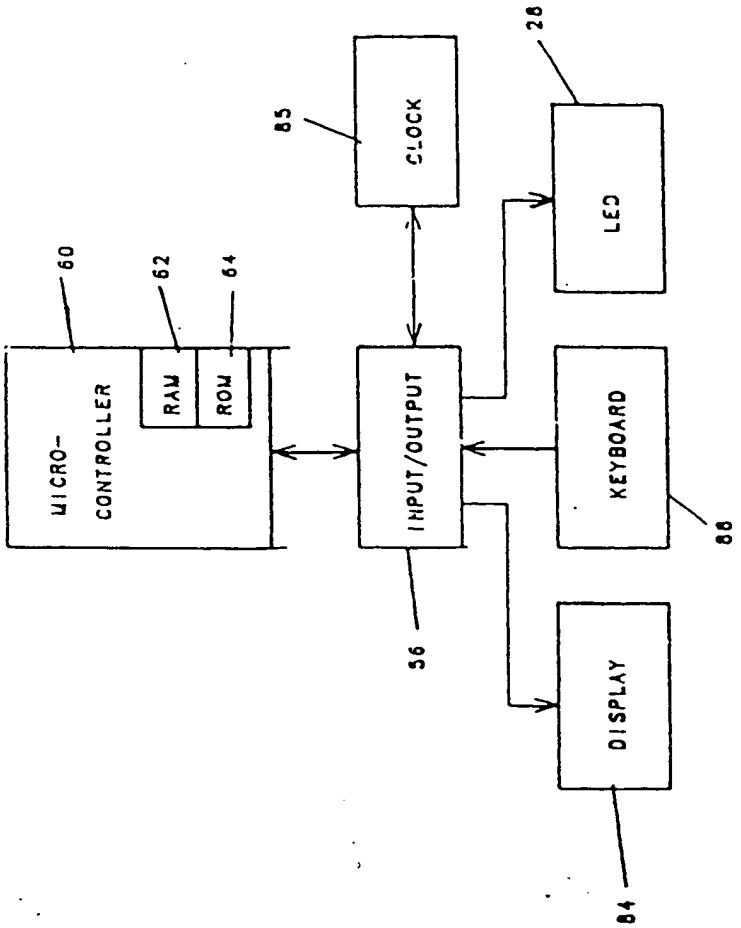
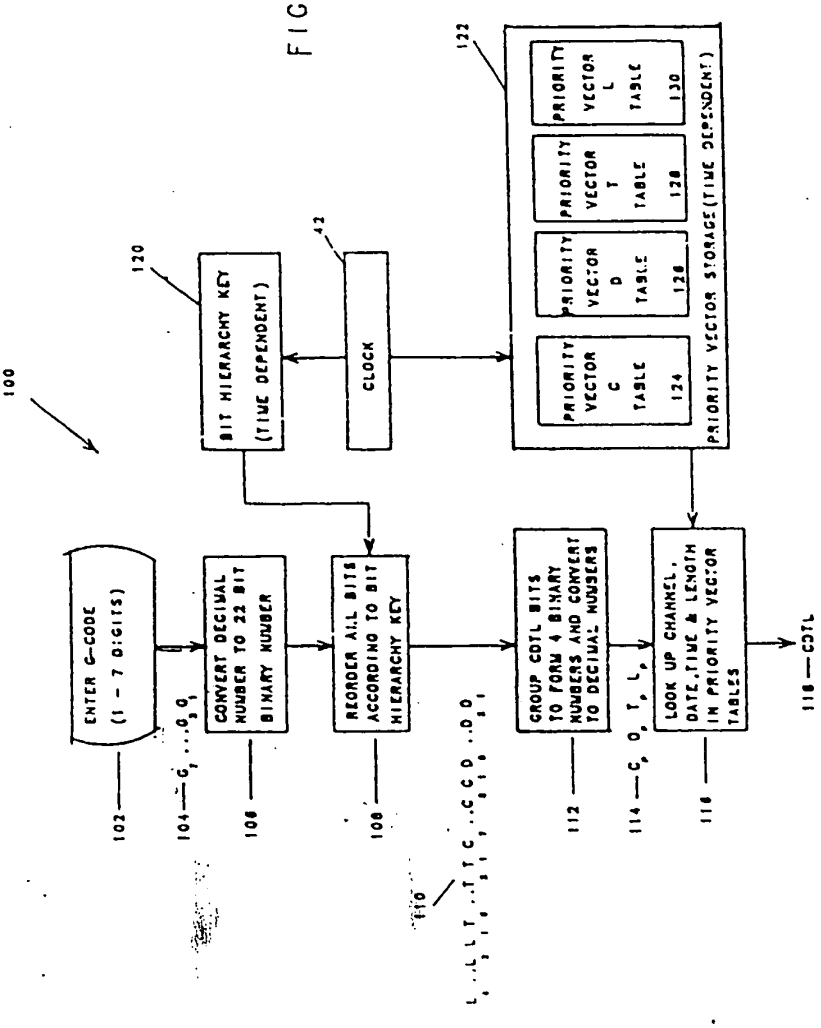

MICRO-
CONTROLLER
RAM
ROM
60
62
64
CLOCK
85
INPUT/OUTPUT
56
LED
28
KEYBOARD
86
DISPLAY
84

FIG. 4

FIG. 6


100
ENTER G-CODE (1 - 7 DIGITS)
102
CONVERT DECIMAL NUMBER TO 22 BIT BINARY NUMBER
104
106
BIT HIERARCHY KEY (TIME DEPENDENT)
120
CLOCK
42
REORDER ALL BITS ACCORDING TO BIT HIERARCHY KEY
108
110
GROUP COTL BITS TO FORM 4 BINARY NUMBERS AND CONVERT TO DECIMAL NUMBERS
112
LOOK UP CHANNEL, DATE, TIME & LENGTH IN PRIORITY VECTOR TABLES
114
116
118 — COTL
122
PRIORITY VECTOR STORAGE (TIME DEPENDENT)
PRIORITY VECTOR C TABLE 124
PRIORITY VECTOR D TABLE 126
PRIORITY VECTOR T TABLE 128
PRIORITY VECTOR L TABLE 130

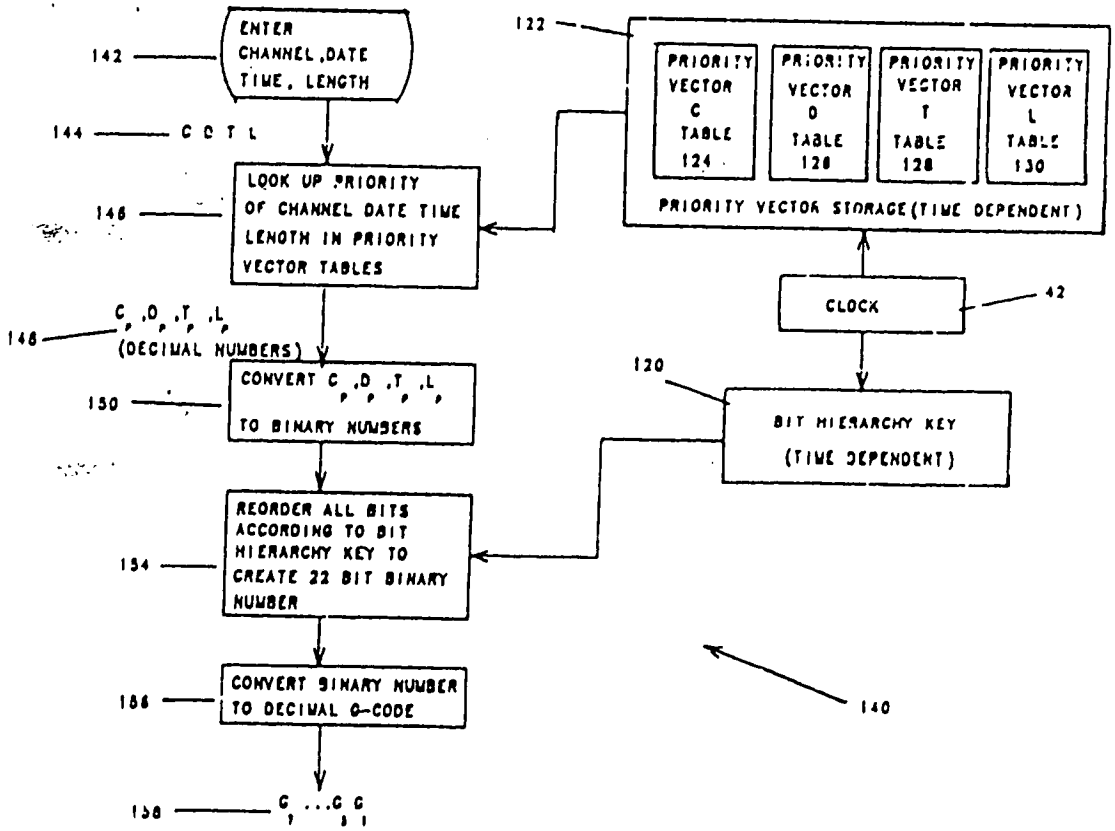


FIG. 7

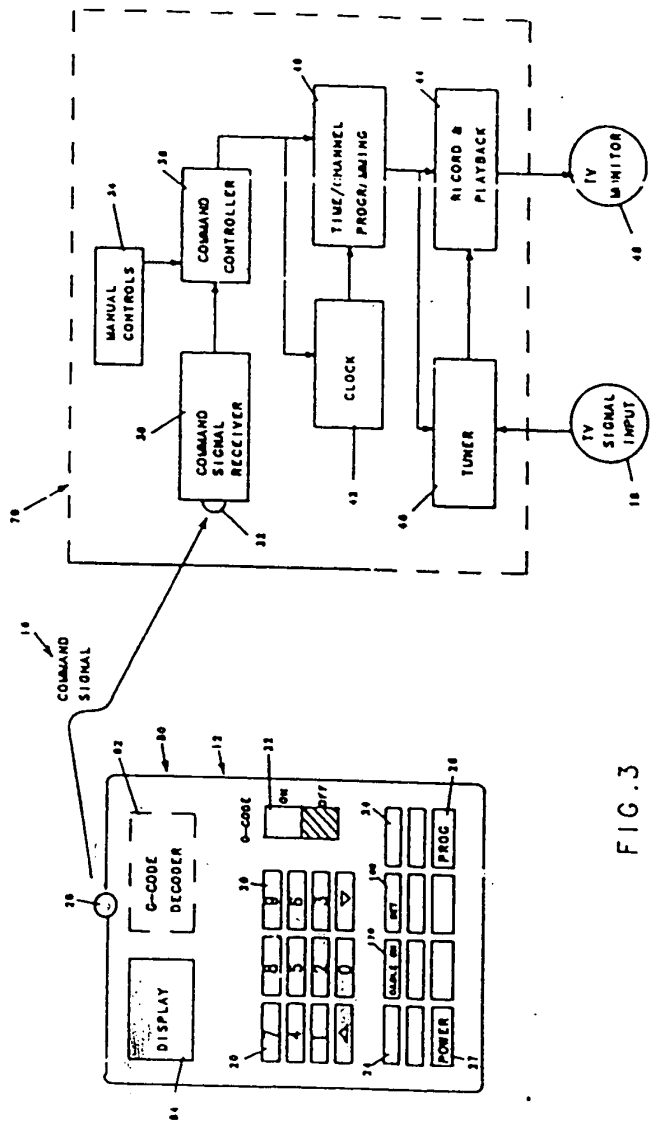

MANUAL CONTROLS
COMMAND CONTROLLER
COMMAND SIGNAL RECEIVER
TIME/CHANNEL PROGRAMMING
CLOCK
RECORD & PLAYBACK
TUNER
TV MONITOR
TV SIGNAL INPUT
COMMAND SIGNAL
G-CODE DECODER
DISPLAY
G-CODE
ON
OFF
PROG
SET
POWER

FIG.3

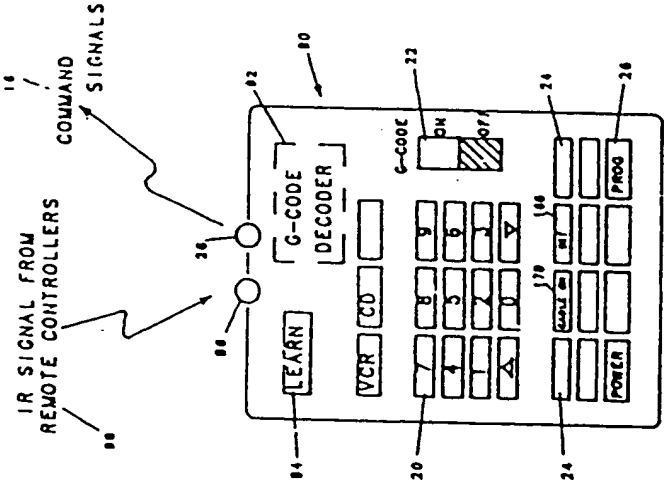

IR SIGNAL FROM REMOTE CONTROLLERS
COMMAND SIGNALS
G-CODE DECODER
LEARN
VCR
CD
G-CODE
ON
OFF
PROG
POWER

FIG.5

clever to be outsmarted, the family devises an elaborate joke to play on him.

208 (4) SPORTS RETROSPECTIVE: 60 min. (48713)
(24) NATURESCENE (5321)
210 A visit to the Colorado National Monument near Grand Junction, where wildflowers, insects and birds are observed.
(38) (62) NOTICIAS (629211) (496649)
(40) DWIGHT THOMPSON—Religion: (68553)
(50) HUMANITIES THROUGH THE ARTS (493065)
(58) BEVERLY HILLBILLIES—Comedy (496727)
188 Con man Shifty Shafer (Phil Silvers) meets Jed in the Ozarks. Jed: Buddy Ebsen.
(15) (A&E) BARRY DOUGLAS—Music: 90 min. (37897)
(16) (DIS) MOVIE—Drama: 70 min. ★★ (23627113)
"The Return of the Big Cat."
(17) (USA) BEYOND 2000—Magazine: 60 min. (5289)
(18) (ESPN) COLLEGE BASKETBALL (332009)
North Carolina at North Carolina State. Carolina defeated the Wolfpack 84-81 on Jan. 21. Steve Bucknall and Kevin Madden combined for 28 points to lead the Tar Heels. Chucky Brown made it interesting, just missing a three-point shot as time expired. (Live)
[Time approximate.]
(20) (HBO) MOVIE (CC)—Science Fiction: (32041)
1 hr., 50 min. ★★
"Batteries Not Included."
(21) (MAX) MOVIE—Documentary: 85 min. ★★★ (34089)
"Sign o' the Times."
(22) (NICK) MR. WIZARD'S WORLD (CC)—Science (7145)
(23) (TNT) NHL HOCKEY (37961)
Los Angeles Kings at Boston Bruins, aired on a 90-minute tape delay.
(26) (TMC) MOVIE—Comedy: 1 hr., 35 min. ★★
"Back Roads." (11828777)
(27) (USA) SHE-RA: PRINCESS OF POWER (3401)
—Cartoon
(28) (WGN) UNTOUCHABLES—Drama (R): 60 min. (5385)
6:30 (11) FAMILY TIES (CC)—Comedy (12557)
206 Mallory's reunion with her college boy friend (John Dukakis) has her worried that she may not be as interesting to him as she once was.
(13) GIMME A BREAK!—Comedy (15593)
Nell (Nell Carter) receives an inheritance and insists on sharing it with everyone—that is, until the check bounces. Addy: Telma Hopkins.
(24) FALL AND RISE OF REGINALD PERRIN —Comedy (19401)
Something is lacking in the dinner party Reggie has for his boss—specifically, the food.
(28) MacNEIL LEHRER NEWSHOUR (78729)
(34) NOTICIERO UNIVISION—Ramos/Salinas (770011)
(50) BUONGIORNA ITALIA!—Instruction (507145)
(52) NOTICIERO TELEMUNDO/CNN (510729)
188 —Salazar/Gamboa
(56) HOGAN'S HEROES—Comedy (510857)
Carter's masquerade as a traitor may be kaput: a lovely Fraulein is trying to poison him.
(10) (NICK) DOUBLE DARE—Game (29225)
(11) (ESPN) VIDEOCOUNTRY (29129)
(22) (USA) CARTOON EXPRESS (23561)
7 PM (5) CHARLES IN CHARGE (CC)—Comedy (1065)
While planning a pizza-parlor party, Charles alienates the Powell children by dismissing their suggestions about organizing the event.
(5) FAMILY TIES (CC)—Comedy (1225)
The family's cousin June (Danielle Von Zerneck) stops by to tell them about her trip to Europe—but instead reminisces about past visits with the Keatons. Alex: Michael J. Fox.
(7) (2) ABC NEWS (CC) (1001) (1129)
(9) LOVE CONNECTION—Game (4841)
(11) M*A*S*H (1257)
Conclusion. An emergency convinces Radar that he's more needed in Korea than at home. Van Kirk: Lee de Broux. Radar: Gary Burghoff.
(13) WHEEL OF FORTUNE (CC)—Game (3113)
(18) LE JOURNAL TELEVISE—In French (66473)
(24) EUROPEAN JOURNAL—Newsmagazine (5001)
(28) NIGHTLY BUSINESS REPORT (62409)
Commentator: Lester Thurow.

212

200

FIG. 9

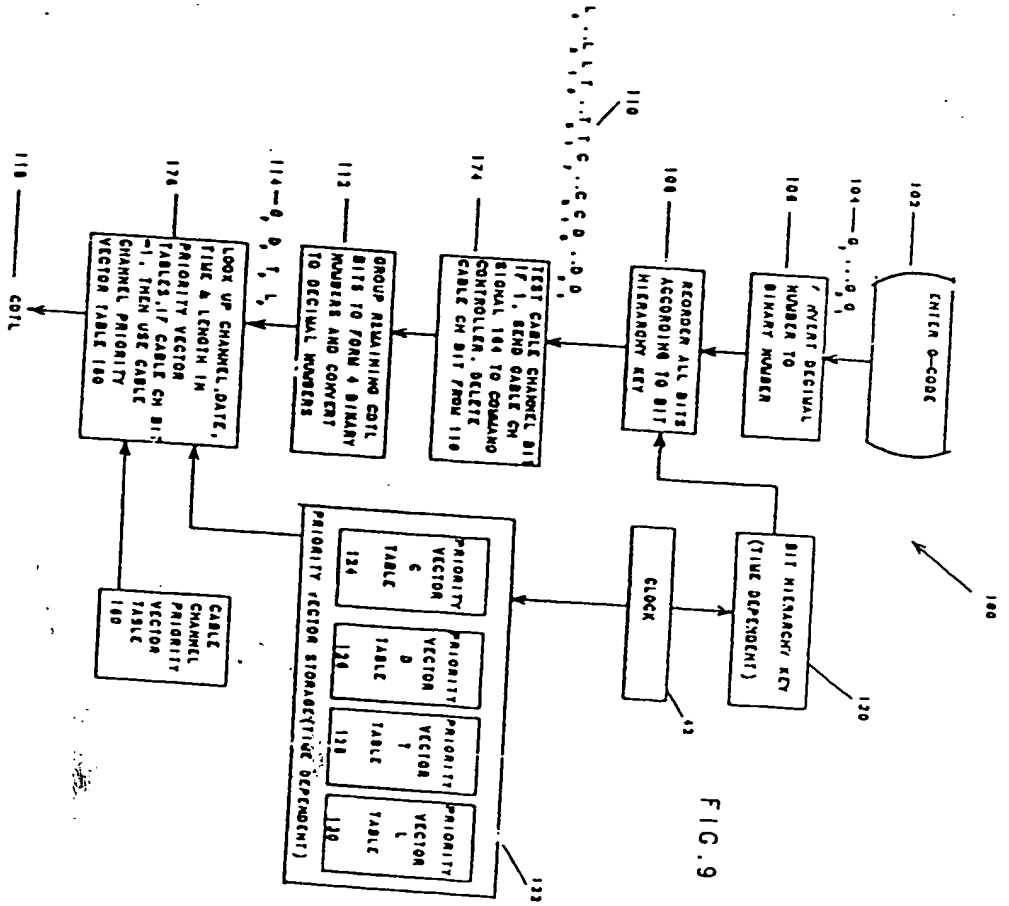

ENTER G-CODE
102
INVERT DECIMAL NUMBER TO BINARY NUMBER
106
REORDER ALL BITS ACCORDING TO BIT HIERARCHY KEY
108
TEST CABLE CHANNEL BIT IF 1, SEND CABLE CH SIGNAL 104 TO COMMAND CONTROLLER, DELETE CABLE CH BIT FROM 110
114
GROUP REMAINING COIL BITS TO FORM 4 BINARY NUMBERS AND CONVERT TO DECIMAL NUMBERS
112
LOOK UP CHANNEL, DATE, TIME & LENGTH IN PRIORITY VECTOR TABLES, IF CABLE CH BIT =1, THEN USE CABLE CHANNEL PRIORITY VECTOR TABLE 130
116
COIL
118
BIT HIERARCHY KEY (TIME DEPENDENT)
120
CLOCK
122
PRIORITY VECTOR STORAGE(TIME DEPENDENT)
132
PRIORITY VECTOR C TABLE 124
PRIORITY VECTOR B TABLE 126
PRIORITY VECTOR 1 TABLE 128
PRIORITY VECTOR L TABLE 130
CABLE CHANNEL PRIORITY VECTOR TABLE 130
100

FIG. 9

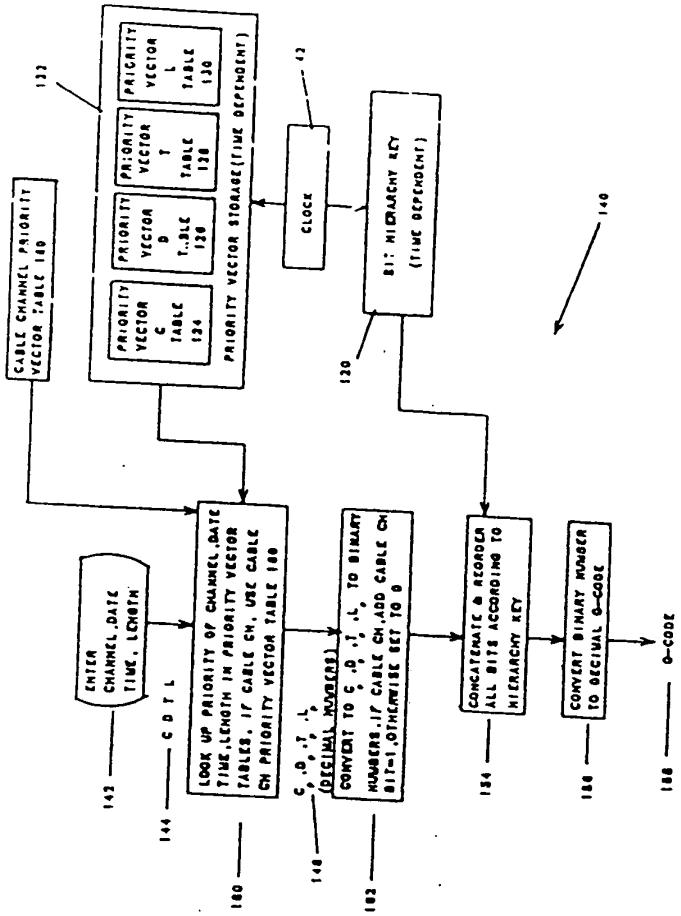

CABLE CHANNEL PRIORITY VECTOR TABLE 160
PRIORITY VECTOR STORAGE (TIME DEPENDENT)
PRIORITY VECTOR C TABLE 124
PRIORITY VECTOR 0 TABLE 126
PRIORITY VECTOR 7 TABLE 128
PRIORITY VECTOR 1 TABLE 130
122
CLOCK
42
B1: HIERARCHY KEY (TIME DEPENDENT)
120
140
ENTER CHANNEL, DATE TIME, LENGTH
142
C D T L
144
LOOK UP PRIORITY OF CHANNEL, DATE TIME, LENGTH IN PRIORITY VECTOR TABLES. IF CABLE CH, USE CABLE CH PRIORITY VECTOR TABLE 160
160
C, 0, 7, 1,
(DECIMAL NUMBERS)
146
CONVERT TO C, 0, 7, 1, TO BINARY NUMBERS. IF CABLE CH, ADD CABLE CH BIT=1, OTHERWISE SET TO 0
162
CONCATENATE & RECORDS ALL BITS ACCORDING TO HIERARCHY KEY
164
CONVERT BINARY NUMBER TO DECIMAL G-CODE
166
G-CODE
168

FIG.10

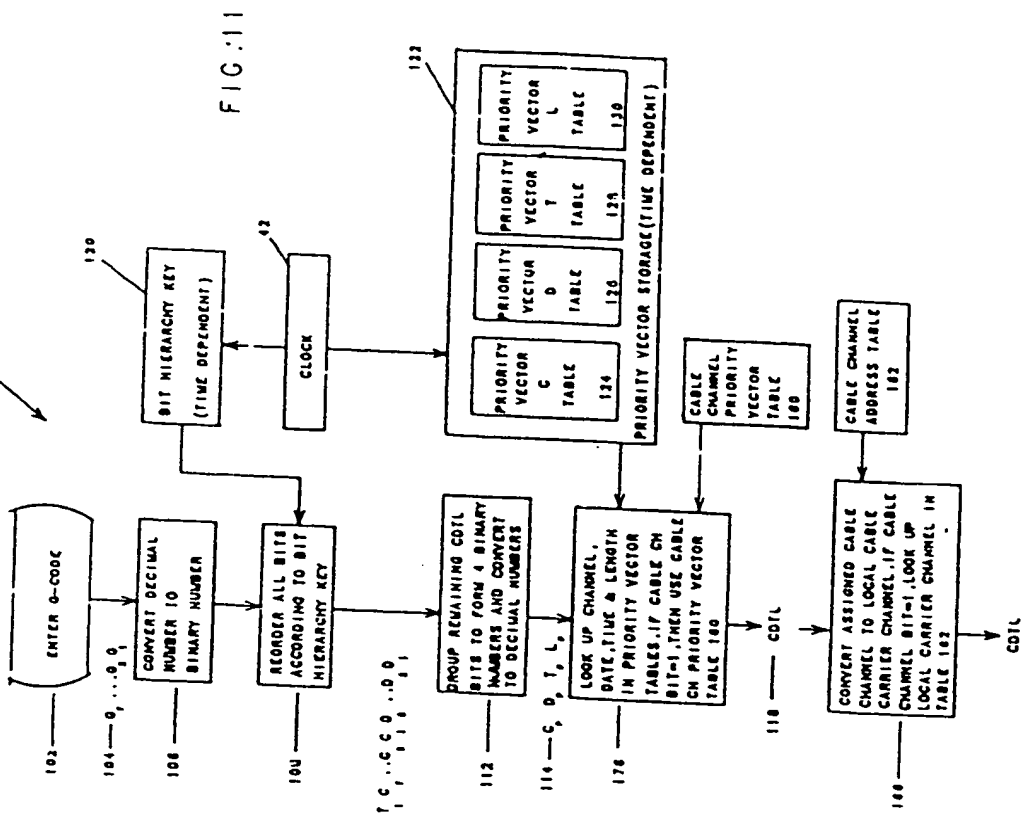

100
ENTER 6-CODE
102
CONVERT DECIMAL NUMBER TO BINARY NUMBER
104
106
BIT HIERARCHY KEY (TIME DEPENDENT)
120
CLOCK
42
REORDER ALL BITS ACCORDING TO BIT HIERARCHY KEY
108
110
GROUP REMAINING COIL BITS TO FORM 4 BINARY NUMBERS AND CONVERT TO DECIMAL NUMBERS
112
114
PRIORITY VECTOR STORAGE (TIME DEPENDENT)
122
PRIORITY VECTOR C TABLE 124
PRIORITY VECTOR D TABLE 126
PRIORITY VECTOR T TABLE 128
PRIORITY VECTOR L TABLE 130
CABLE CHANNEL PRIORITY VECTOR TABLE 180
CABLE CHANNEL ADDRESS TABLE 182
LOOK UP CHANNEL, DATE, TIME & LENGTH IN PRIORITY VECTOR TABLES. IF CABLE CH BIT=1, THEN USE CABLE CH PRIORITY VECTOR TABLE 180
116
118
COIL
CONVERT ASSIGNED CABLE CHANNEL TO LOCAL CABLE CARRIER CHANNEL. IF CABLE CHANNEL BIT=1, LOOK UP LOCAL CARRIER CHANNEL IN TABLE 182
188
COIL

FIG:11

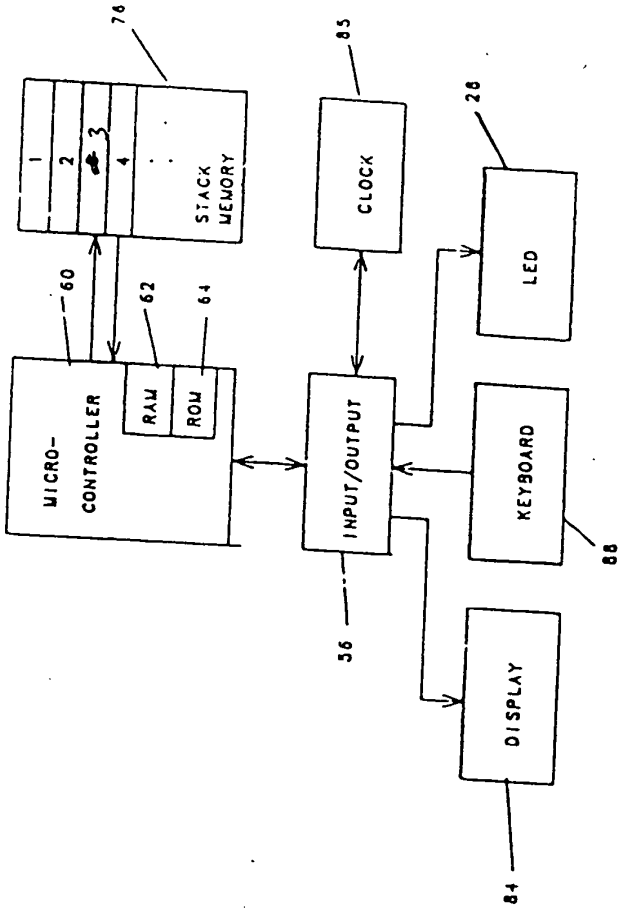

76
1
2
3
4
STACK MEMORY
85
CLOCK
28
LED
60
62
64
MICRO-CONTROLLER
RAM
ROM
INPUT/OUTPUT
KEYBOARD
88
56
DISPLAY
84

FIG. 12

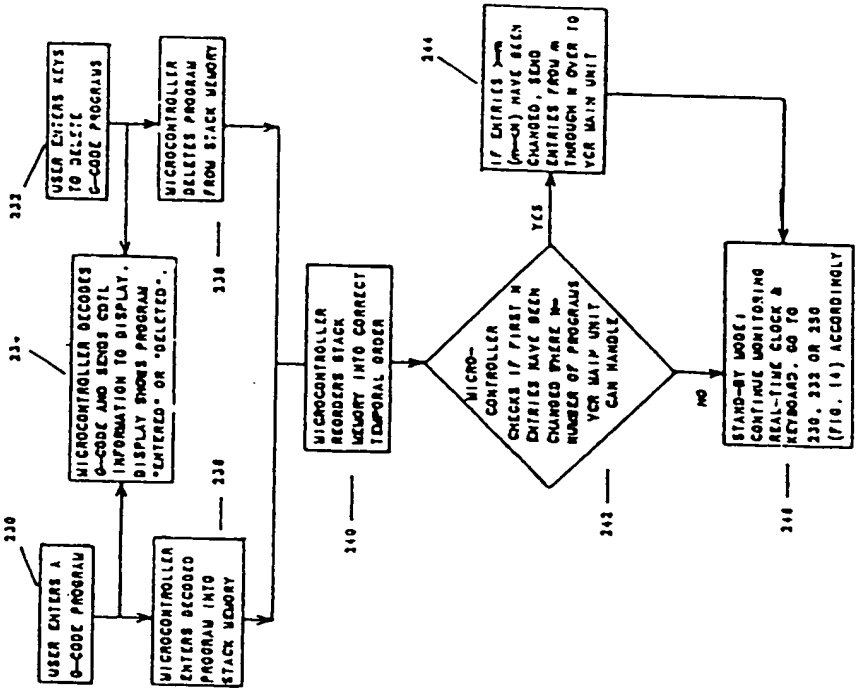

USER ENTERS A G-CODE PROGRAM
230
MICROCONTROLLER ENTERS DECODED PROGRAM INTO STACK MEMORY
238
USER ENTERS KEYS TO DELETE G-CODE PROGRAMS
232
MICROCONTROLLER DECODES G-CODE AND SENDS COIL INFORMATION TO DISPLAY. DISPLAY SHOWS PROGRAM "ENTERED" OR "DELETED".
234
MICROCONTROLLER DELETES PROGRAM FROM STACK MEMORY
236
MICROCONTROLLER REORDERS STACK MEMORY INTO CORRECT TEMPORAL ORDER
240
MICRO-CONTROLLER CHECKS IF FIRST N ENTRIES HAVE BEEN CHANGED WHERE N= NUMBER OF PROGRAMS VCR MAIN UNIT CAN HANDLE
242
YES
IF ENTRIES 1 THROUGH N (n=8) HAVE BEEN CHANGED, SEND ENTRIES FROM n THROUGH N OVER TO VCR MAIN UNIT
244
NO
STAND-BY MODE: CONTINUE MONITORING REAL-TIME CLOCK & KEYBOARD. GO TO 230, 232 OR 250 (FIG. 14) ACCORDINGLY
246

FIG. 13

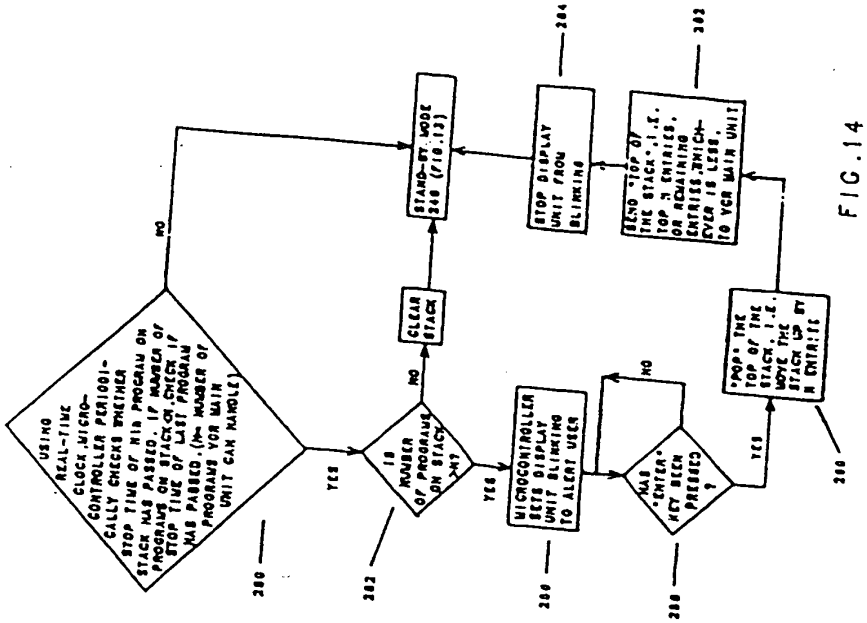

USING REAL-TIME CLOCK, MICRO-CONTROLLER PERIODICALLY CHECKS WHETHER STOP TIME OF NEXT PROGRAM ON STACK HAS PASSED. IF NUMBER OF PROGRAMS ON STACK EXCEEDS 1 AND STOP TIME OF LAST PROGRAM HAS PASSED (i.e. NUMBER OF PROGRAMS FOR MAIN UNIT CAN HANDLE)
NO
YES
CLEAR STACK
STAND-BY MODE (FIG.13)
IS NUMBER OF PROGRAMS ON STACK > 1 ?
NO
YES
MICROCONTROLLER SETS DISPLAY UNIT BLINKING TO ALERT USER
HAS "ENTER" KEY BEEN PRESSED ?
NO
YES
"POP" THE TOP OF THE STACK (i.e. MOVE THE STACK UP BY N ENTRIES)
SEND "TOP OF THE STACK", i.e. TOP N ENTRIES, OR REMAINING ENTRIES, WHICHEVER IS LESS, TO MAIN UNIT
STOP DISPLAY UNIT FROM BLINKING
200
202
204
206
208
210
212

FIG.14